Aviation Week & Space Technology

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October 28, 1963

SPECIAL REPORT:

Apollo Spacesuit Design Program

Apollo Suit Prototype With Life Support Pack

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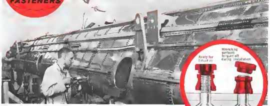

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AEROSPACE CALENDAR

Nov. 4-5—Annual General Meeting, Air Transport Assn. of Canada, Seigniory Club, Montebello, Quebec, Canada

Nov. 4-6—Vehicle Design and Propulsion Meeting, American Institute of Aeronautics and Astronautics/Air Force Systems Command, Wright Patterson AFB, Dayton, Ohio (Classified)

Nov. 4-6—Northeast Electronics Research and Engineering Meeting (NEREM), Institute of Electrical and Electronics Engineers, Commonwealth Armory/Somerset Hotel, Boston, Mass.

Nov. 4-6—Noise Analysis in Nuclear Systems Conference, Gainesville, Fla. Sponsors: Atomic Energy Commission, University of Florida

Nov. 4-6—First Meeting, Society of Engineering Science, Purdue University, Lafayette, Ind.

Nov. 5-15—17th Institute on Air Transportation Management. For information: Dr. Marvin L. Fair, Director, Transportation Program, The American University, 1901 F St., N.W., Washington, D.C.

Nov. 6-7—Low Cost Navigation Symposium, Airport Marine, Los Angeles, Calif. Sponsors: Institute of Navigation, Instrument Div., Lear Siegler, Inc.

Nov. 6-8—Annual Meeting and Exposition, Society for Experimental Stress Analysis, Statler Hilton Hotel, Boston, Mass.

Nov. 7-8—24th National Meeting, Operations Research Society of America, Olympic Hotel, Seattle, Wash.

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AVIATION WEEK & Space Technology

October 28, 1963

Vol. 79, No. 18

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948). Founder. Non-paid listing for directions regarding subscription or change of address. Executive, Editorial, Circulation and Advertising Offices, McGraw-Hill Building, 330 West 42nd Street, New York, N.Y. 10036. Printed at Albany, N.Y. OFFICERS OF THE PUBLICATIONS DIVISION: Shelton Fisher, President-Vice Presidents: George H. Reppert, Jr., Operations; John R. Callahan, Editorial; Erwin E. DeGraff, Circulation; Donald C. McGraw, Jr., Advertising Sales; Angelo B. Venezian, Marketing. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

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Single copies 75¢. Subscription rates—United States and possessions $7 one year; Canada $8 one year; All other countries, $20 one year.

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Second class postage paid at Albany, N.Y. Printed in U.S.A. Title registered in U.S. Patent Office.

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AEROSPACE CALENDAR

(Continued from page 5)

Nov. 7-8—Joint Technical Conference, Disneyland Hotel, Anaheim, Calif. American Society of Mechanical Engineers; American Institute of Aeronautics and Astronautics; Society of Automotive Engineers; American Society for Quality Control.

Nov. 9-11—1963 Space Fair, Pacific Missile Range Headquarters, Point Mugu, Calif.

Nov. 11-15—Institute on Reliability Engineering and Management, Tucson, Ariz. Sponsors: University of Arizona, Northrop Space Laboratories.

Nov. 12-14—Symposium on Supersonic Airliners, London, England. Sponsors: British, French and U.S. Air Line Pilot Associations.

Nov. 12-14—Fall Joint Computer Conference, American Federation of Information Processing Societies, Las Vegas Convention Center, Las Vegas, Nev.

Nov. 13-14—Seminar on Automatic Checkout Equipment and Techniques, Columbus, Ohio. Co-sponsors: NASA's George C. Marshall Space Flight Center, Battelle Memorial Institute.

Nov. 13-14—Fifth General Assembly, International Technical Institute for Flight Engineers, La Maison des Ailes, Brussels, Belgium.

Nov. 13-15—15th Annual Meeting, Armed Forces Chemical Assn., Statler Hilton Hotel, Washington, D.C. Host: Air Force.

Nov. 18-19—Symposium on Unconventional Inertial Sensors, Farmingdale, N.Y. Sponsors: Republic Aviation Corp., N.Y. Scientific and Technical Liaison Office, Air Force Systems Command's Research and Technology Div., Bureau of Naval Weapons. (Classified.)

Nov. 18-20—Sixth National Symposium, Society of Aerospace Material and Process Engineers, Olympic Hotel, Seattle, Wash.

Nov. 18-22—10th National Plastics Exposition, Society of the Plastics Industry, McCormick Place, Chicago, Ill.

Nov. 19-21—1963 AtomFair, Hotel Americana, New York, N.Y. Co-sponsors: Atomic Industrial Forum, American Nuclear Society.

Nov. 19-21—Conference on Stratosphere-Mesosphere Structure, El Paso, Tex. Sponsors: Texas Western College; American Meteorological Society, AIAA.

Nov. 19-21—42nd Annual Meeting, Aviation Distributors and Manufacturers Assn., Shamrock Hilton, Houston, Tex.

Dec. 3-5—Joint Annual Meeting and Convention: National Pilots Assn. and National Aviation Trades Assn. including the National Air Taxi Conference, Fontainebleau Hotel, Miami Beach, Fla.

Dec. 3-5—33rd Symposium on Shock, Vibration and Associated Environments, U.S. Naval Research Laboratory, Washington, D.C.

Dec. 3-5—Annual Meeting, Assembly of the Radio Technical Commission for Aeronautics, Washington, D.C.

Dec. 4-6—Testing of Manned Flight Systems Conference, American Institute of Aeronautics and Astronautics/NASA Flight Research Center, Edwards AFB, Calif.

Dec. 4-6—Ultrasonics Engineering Symposium.

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AEROSPACE CALENDAR

(Continued from page 7)

sium, Institute of Electrical and Electronics Engineers, Marriott Motor Hotel, Washington, D.C.

Dec. 5-6—14th National Conference on Vehicular Communications, Institute of Electrical and Electronics Engineers, Adolphus Hotel, Dallas, Tex.

Dec. 6—Fourth Annual Seminar on the Reliability of Space Vehicles, Institute of Electrical and Electronics Engineers, Airport Marina Hotel, Los Angeles.

Dec. 11-13—Conference on Heterogeneous Combustion, American Institute of Aeronautics and Astronautics, Palm Beach, Fla.

Dec. 16-17—Conference on Non-Linear Processes in the Ionosphere, National Bureau of Standards, Boulder Laboratories, Boulder, Colo.

Dec. 16—Sixth Annual Army Aviation Contract Services Symposium, Mayflower Hotel, Washington, D.C. Sponsor: National AeroSpace Services Assn.

Dec. 30—Annual Meeting, American Assn. for the Advancement of Science, Cleveland, Ohio.

Jan. 7-9—Tenth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D.C.

Jan. 19-23—16th Annual Convention, Helicopter Assn. of America, San Marcos Inn, Chandler, Ariz.

Jan. 20-23—Annual Winter Meeting, American Institute of Aeronautics and Astronautics, Hotel Astor, New York, N.Y.

Jan. 29-31—Solid Propellant Rocket Conference, American Institute of Aeronautics and Astronautics, Palo Alto, Calif.

Feb. 5-7—Fifth Winter Convention on Military Electronics, Institute of Electrical and Electronics Engineers, Ambassador Hotel, Los Angeles, Calif.

Mar. 9-10—Aerodynamic Testing Conference, Marriott Twin Bridges Motor Hotel, Washington, D.C. Sponsors: American Institute of Aeronautics and Astronautics; U.S. Navy.

Mar. 23-26—International Convention, Institute of Electrical and Electronics Engineers, Coliseum and New York Hilton, New York, N.Y.

Apr. 1-2—Fifth Symposium on Engineering Aspects of Magnetohydrodynamics, Institute of Electrical and Electronics Engineers, Massachusetts Institute of Technology, Cambridge, Mass.

Apr. 1-3—Fifth Annual Structures and Materials Conference, American Institute of Aeronautics and Astronautics, Riviera Hotel, Palm Springs, Calif.

Apr. 6-8—International Conference on Non-linear Magnetics (Intermag), Institute of Electrical and Electronics Engineers, Shoreham Hotel, Washington, D.C.

Apr. 19-25—International Conference & Exhibit on Aerospace Electro-Technology, Institute of Electrical and Electronics Engineers, Westward-Ho Hotel, Phoenix, Ariz.

Apr. 24-May 3—1964 German Air Show, Hanover Airport, Hanover, West Germany.

June 29-July 2—First Annual Meeting & Technical Display, American Institute of Aeronautics and Astronautics, Sheraton Park Hotel, Washington, D.C.

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CONTENTS

COVER. Front and back views of the first prototype of National Aeronautics and Space Administration's Apollo spacesuit are shown in a composite photo. United Aircraft's Hamilton Standard Div., Windsor Locks, Conn., is prime contractor for the program and is building the backpack, which astronauts will use during lunar explorations. International Latex Corp., Dover, Del., is building the suit. For further details and photos of the suit, see p. 48.

PICTURE CREDITS
Cover—Ray Kahn, Hamilton Standard; 24—Northrop Norair Div.; 27—Assn. of the U. S. Army; 30—NASA; 35—Bun Aperibe; 40, 45—Hamilton Standard; 51—Aerojet General; 63—USAF; 67—E. C. Armees; 70, 71, 73, 87—Autonetics; 91—NASA; 99—Piper Aircraft Corp.; 103—Cessna

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Was Big Lift Big Enough?

Operation Big Lift provided an impressive demonstration of improved U.S. military airlift capability in flying the 15,000-man 2nd Armored Division plus a significant quantity of supporting tactical aircraft to Europe within a 72 hr. period (see p. 26). However, the real lesson learned was put very succinctly by an officer at the main U.S. airhead at Ft. Hood, Tex., who said:

"This is a jet age concept geared to the pace of a piston engine fleet."

It is rather sad to note that the Military Air Transport Service could deploy only 26 of its jet-powered Boeing C-135 transports in Big Lift and that the bulk of the troops was transported by the venerable Douglas C-124 and its Pratt & Whitney piston engines. It underscores the wisdom of the decision taken early in the Kennedy Administration to give high priority to improving the capacity and speed of the U.S. military airlift capability by pushing development of a new jet-powered air freighter, which has now emerged as the Lockheed C-141. It also emphasizes the need for still further development of even larger logistics carriers such as the Douglas CX-4 proposal, taking advantage of the increased efficiencies and capabilities offered by an across-the-board improvement in aeronautical technology.

Lessons of Berlin, Korea

The importance of military airlift was proved during World War 2, and the need for the flexibility it offers the cold war era was demonstrated during the 1948-49 blockade of Berlin and the Korean war. Without even the makeshift airlifts during those operations, Berlin would have been starved into submission and Communist forces would have occupied the entire Korean peninsula.

Both the Berlin and Korean airlifts were largely patched together from well-worn World War 2 transports—the trusty Douglas C-47 and C-54 and the Curtiss C-46. The airlift lessons of those critical operations were quickly forgotten in the military planning of the 1950s. A few stout Air Force voices, such as Bill Tunner, Clement McMullen and "Red" Hudnell howled about the vital necessity for expanded airlift capability in the compacted time scale of the nuclear era. But at budget time the transport items were always the first to feel the economy ax. The modernization of the military transport fleet and the development of special military cargo planes were very low on the Defense Dept. priority lists. Strategic Air Command bombers and ICBMs absorbed the largest slice of the defense dollar. Neither the Air Force nor the Army did much about coordinating their equipment or operations to achieve much genuine mobility with even the airlift available.

One of the bright spots of the Kennedy Administration and the regime of Defense Secretary McNamara in the Pentagon has been their appreciation of the role of air mobility for every type of military operation short of full-scale nuclear war, and their action in raising its development priority considerably on the military scale.

The appearance of the Lockheed C-141 in military service in 1965 will be the first major evidence of this change, although the existing transport fleet has been bolstered with advanced versions of the C-130 and more C-135s. It is also encouraging to see the Defense Dept. looking beyond the C-141, which was based on a traditional state-of-the-art technology when it was laid down in 1961, to the possibilities that have been opened for even more efficient transports by major advances in aerodynamic and propulsion research during the past few years.

SST's Military Role

In light of these trends, it is rather ridiculous for the Defense Dept. to maintain that there is no military requirement for a supersonic transport. This illogical denial that doubling of speed would offer any military advantage may stem from a bureaucratic desire to keep clear of the Federal Aviation Agency's prerogatives in the supersonic transport development program. But it would certainly bolster the supersonic transport cause if its future military advantages were candidly outlined to the Congress and the taxpayers who are being asked to finance this effort.

The 72 hr. time span to transport the personnel of an armored division from Texas to Germany is certainly sensational by the standards of Korean war airlift. But it still leaves much to be desired for a jet age operation.

Obtaining modern transport equipment is only part of the job of creating military air mobility. Both the Army and Air Force needed considerable stimulus from Mr. McNamara and his aides to begin the painstaking task of blending their divergent doctrines and equipment into a usable military tactic.

Operations such as Big Lift and the other similar exercises planned for the future are vitally necessary in testing the operational procedures that will permit the new jet transport equipment to function with maximum military results. In an era when the probability of an uncontrolled brush fire war on some remote geographic periphery is much stronger than that of all-out nuclear war, a well developed air mobility capability offers the only flexible and economical method of maintaining and operating the fire brigade.

Operation Big Lift was certainly not big enough nor fast enough. But it was a big step in the right direction. The continued priority on developing the equipment and techniques required for massive air mobility in the jet age will provide this nation with additional defensive power that it vitally needs.

—Robert Hotz

WHO'S WHERE

In the Front Office

Lloyd L. Kelly, president, Simulation and Control Group of General Precision, Inc., Binghamton, N. Y., succeeding **W. W. Wood, Jr.**, resigned. Mr. Kelly continues as president of the Link Div. of the Group.

Andrew J. Unetic, executive vice president Kinetics Corp., Solana Beach, Calif.

James A. Carmack, vice president marketing, Hughes Tool Co.'s Aircraft Div., Culver City, Calif.

Marshall D. Kochman, vice president properties and facilities, American Airlines Inc., will succeed **William H. Miller**, retiring Nov. 1, as vice president in charge of the New York area.

Donald R. Neilson, vice president research and development, Bonanza Air Lines and **Richard A. Rogers**, vice president-industrial relations.

F. J. Van Poppelen, Jr., vice president and general manager, Signetics Corp., Sunnyvale, Calif.

Torstem Strand, assistant to the vice president of engineering, General Dynamics/Convair, San Diego, Calif.

Charles H. Zimmerman, chief engineer, Army Materiel Command (AW Sept. 2, p. 24). **A. J. Evans** now acting director of aeronautical research programs for National Aeronautics and Space Administration, replacing Mr. Zimmerman.

Ministry of Aviation (England) has appointed **Air Commodore B. Robinson** as director of RAF Aircraft Development as of Jan. 1, 1964, succeeding **Air Commodore H. M. Russell**, retiring. Also **Capt. S. Grattan-Cooper**, Deputy Controller of Aircraft (Royal Navy), succeeding **Rear Adm. J. A. Ievers**.

Honors and Elections

J. M. Conners, engineering manager of Grumman Aircraft Engineering Corp., has been appointed co-chairman of the Society of Automotive Engineers' Aerospace Accessories and Equipment Div.

Changes

Clifford I. Cummings, manager, Advanced Systems Development Operations, Electro-Optical Systems, Inc., Pasadena, Calif., and **Charles W. Stephens**, manager of the newly formed Optics Div. of EOS.

Robert James Hanville, director of research and engineering, Aerospace Div. of Walter Kidde & Company, Inc., Belleville, N. J., succeeding **J. J. Maremek**, who has resigned.

Edward Z. Gray, director of advanced studies, Office of Manned Space Flight, National Aeronautics and Space Administration, succeeding **Dr. William A. Lee**, who is moving to the Apollo Program Office, NASA's Manned Spaceed Flight Center, Houston, Tex.

Paul F. Glaser, director, Electical Ground Support Equipment Laboratory, Space Technology Laboratories, Inc., Redondo Beach, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc., and **Richard D. Gloor**, associate director.

(Continued on page 104)

INDUSTRY OBSERVER

▶ Directive which would give commanders of specified and unified commands greater responsibility for establishing characteristics of command and control systems is being circulated by Deputy Defense Secretary Roswell Gilpatric. If approved, the commanders will build up their scientific staffs to handle the new role.

▶ USAF planners are studying the possible use of aircraft with a greater range than any now flying, to carry parasite aircraft for special missions which could include strike or fast flight reconnaissance.

▶ Development of an advanced anti-radar missile, designated Butcher Bird, is under consideration by Navy's BuWeps. Missile would be an air-to-ground type which might be launched at least 50 mi. from the target.

▶ Feasibility demonstrations of the 156-in.-dia. solid-propellant motor program (AW Feb. 11, p. 50) may be delayed because of a problem with 18% nickel maraging steel motor case material. Small separations or recurring flaking of the surface areas of the material might affect the case strength, program personnel feel. Cause of the separations is being investigated.

▶ Douglas Aircraft's Charlotte Div. is investigating feasibility of redesigning the Nike Hercules anti-aircraft missile to a single-stage configuration instead of the present two-stage arrangement, which consists of a booster cluster and a single upper sustainer stage. Total impulse would exceed 800,000 lb.-sec.

▶ Use of the Northrop F-5A as a close-support aircraft in limited war has been analyzed by the company's Norair Div. In this capacity the F-5A probably would be fitted with assist rockets for takeoff and an arresting device for landing. Limited war capabilities were one of five areas analyzed under Project Forecast (AW Sept. 9, p. 28).

▶ Solid propellant rocket safety systems for submarines are being studied by Thiokol Chemical Corp., Bristol, Pa., under Navy contract. The concept would use solid propellant rockets to propel a disabled submarine to the surface quickly in the event of an underwater accident. The Navy let the contract shortly after the loss of the nuclear submarine U.S.S. Thresher.

▶ One bidder on USAF's orbital space station competition estimates that by using an Apollo command module and a Gemini ferry vehicle, the program would cost $2 billion over a 5-year period based on monthly replacement of the four-man crew.

▶ Bell Aerosystems Co. has developed an advanced version of the Agena engine expected to deliver more than 20,000-lb. thrust—an increase of more than 5,000 lb. over the current version. There is a possibility that the improved engine may be considered by NASA's Manned Spacecraft Center as a backup for the Apollo service module engine.

▶ Strong possibility exists that solid motors may be used as auxiliary propulsion for various Saturn configurations to boost payload capacity as well as compensating for any unrecoverable weight increases in Saturn stages.

▶ Systems for obtaining physiological measurements of pilots in the X-15A2 aircraft now being refurbished at North American Aviation's Los Angeles Div. have been redesigned to accommodate avionic equipment which has been made integral with the pressure suit. Delivery of the Mach 8 aircraft (AW Oct. 14, p. 28) to Edwards AFB may be delayed due to resealing necessary to eliminate cockpit leaks.

▶ Antares 2 solid propellant rocket for a 2-ft.-dia., 200-lb. Apollo command module model has been delivered to Cape Canaveral by Ling-Temco-Vought for NASA's experiment to determine heat effects on Apollo during re-entry. Two Antares flight vehicles are contemplated to be supplemented by one ground test unit. The Antares stage, powered by the Hercules X-259 motor, will be boosted by an Atlas.

Washington Roundup

Korth Case Issues

Basic legal question in the Fred Korth case (see p. 22) is whether any of his activities as Navy Secretary led to decisions that could benefit him personally and thus result in violation of conflict of interest laws.

Justice Dept. is taking the stand that the letters Korth wrote while Navy Secretary were indiscreet but not illegal. But Republicans in Congress are not accepting that opinion and are demanding a formal inquiry into the legalities of the situation.

Current thinking among congressional lawyers involved in the Senate's TFX investigation is that a statutory conflict of interest violation would be difficult to prove, but that a breach of the Kennedy Administration's written ethics would not. Chairman John L. McClellan of the Senate investigating subcommittee has contended all along that Korth should have disqualified himself from participating in the TFX decision because of his former close associations with General Dynamics, the winning contractor.

Republicans are having a field day as the Kennedy Administration remains mum about the politically embarrassing Korth resignation. Rep. Bill Stinson, Republican from Boeing's home state of Washington and a Navy veteran, made this quip about the widely circulated story that Korth was resigning because he could not persuade Defense Secretary Robert S. McNamara to make the next Navy aircraft carrier nuclear powered:

"For the first time in the history of the United States Navy an aircraft carrier has been used to lay down a smokescreen."

Shepard's New Interest

Texas banking is losing a Navy secretary but gaining an astronaut through Navy Cdr. Alan B. Shepard's decision to buy into the First National Bank of Baytown, Tex., near the Manned Spacecraft Center at Houston. The astronaut and two businessmen invested $1.3 million to gain the controlling interest in the $7.2-million bank. He will serve as a director, but the space agency forbids his name to be used in promotion. Space agency says it approved the deal but does not want any other astronaut to become an executive of the bank.

Economy ax is hanging over the Saturn 1-Apollo program as the National Aeronautics and Space Administration considers cutting some of the manned earth orbital flights slated for 1965 and adding them to the Saturn 1B-Apollo flights in 1966-67.

Range Consolidation

Watch for a move to unify the Atlantic and Pacific missile ranges and about a dozen of their supporting facilities by putting them under a new division of the Air Force Systems Command. Secretary McNamara already is weighing proposals to do this—including recommendations from the Air Force, Navy and Army. Vandenberg AFB, now Strategic Air Command's test firing site, would be put under the new division. Pentagon insiders say USAF Maj. Gen. Leighton I. Davis, Atlantic Missile Range commander, would probably head such a command.

Pentagon missileers are enthusing about the accuracy they are now getting with ICBMs. Dr. Albert C. Hall, deputy director of defense research and engineering for space, said recently that "every single missile successfully launched from the Pacific Missile Range and aimed at Eniwetok Island, some 5,000 mi. away, has impacted in its lagoon." At the outset of the ICBM program, there was so much pessimism about accuracy that contract specifications called for landing within 5 naut. mi. of the target even though the military wanted accuracy within 1 naut. mi., Hall said.

Military Researeh Gains

Dr. Jerome B. Wiesner, President Kennedy's scientific adviser, credits the U. S. research on weapons with stimulating "much of our scientific progress over the last 10 years," and warns that the effort must continue unabated until effective international arms controls are well under way. "We must continue the process of refining past achievements in the military area and probing for new possibilities," he said. However, putting nuclear bombs in orbit is not among the worthwhile endeavors he has in mind.

In contrast to that statement before a House space subcommittee, Dr. Linus C. Pauling, Nobel prize-winning chemist, said "something is seriously wrong with our system of values" when the U. S. spends billions for the prestige of landing a man on the moon rather than for relieving human suffering. His remarks disrupted last week's centennial celebration of the National Academy of Sciences here. President Kennedy pleased many of the celebrants by promising to abandon past secrecy about the launching of such purely scientific experiments as Project West Ford and announce them in advance.

Australia will buy 24 USAF-General Dynamics F-111A (TFX) tactical fighter bombers to replace English Electric Canberras, and will lease 30 surplus Boeing B-47Es from SAC, free of charge, as interim aircraft. Originally, Australia planned to buy British TSR 2s as Canberra replacements.

NASA's Goddard Space Flight Center has reversed its earlier decision by opening its symposium on the physics of solar flares Oct. 28-30 to selected members of the press (AW Sept. 23, p. 25).

—Washington Staff

Senate Probers Scrutinize Korth Letters

Outgoing Navy Secretary's correspondence searched for possible TFX partiality and conflict of interest.

By George C. Wilson

Washington—Fred Korth's letters to his friends while he was Navy Secretary are being analyzed by the Senate Permanent Investigations Subcommittee to determine if they suggest any conflict-of-interest or partiality in arriving at his recommendation to give General Dynamics the F-111 (TFX) tactical fighter contract.

Korth, who resigned as Navy Secretary effective Nov. 1, will be asked to testify about the letters and his financial dealings with General Dynamics when he was president of the Continental National Bank in Ft. Worth. General Dynamics/Ft. Worth won the $7-billion F-111 contract over Boeing. The subcommittee hearings are expected to resume late in November with the letters Korth wrote before and after he became Navy Secretary Jan. 4, 1962, a central issue.

On Oct. 19, Korth released many of the letters the subcommittee is analyzing, and said they would "put these rumors to rest" about his resignation being requested. The Justice Dept. has said Korth was not guilty of any conflict of interest. A central question is whether Korth's activities violated the standards of conduct President Kennedy issued in 1961. Even though a technical conflict of interest may not exist," the standards state, "it is desirable to avoid the appearance of such a conflict from a public confidence point of view."

Korth stressed that letters about banking to his friends did not conflict with his official duties, and that letters concerning procurement proposals were handled "on an official basis by the Navy." Following are excerpts from the correspondence that Korth himself released:

▪ **Gen. Lauris Norstad, USAF (ret.),** was requested to have a branch of his corporation deal with the Waxahachie (Tex.) Bank & Trust Co. In a "Dear Gus" letter written Mar. 9, 1963, on Navy stationery to G. E. Holmstrom, senior executive vice president of the Continental National Bank, Korth said: "In connection with some correspondence I have had with General Norstad, who is now president of International Div. of Owings-Corning Fiberglass (sic) Corp., I understand that the corporation recently announced plans for building a new plant at Waxahachie. I am sure that the folks down there are aware of this but if I can be helpful to the bank's friends in connection with General Norstad, let me know."

Holmstrom wrote Korth Mar. 18, 1963, that Continental had contacted Lynn B. Griffith of the Waxahachie Bank & Trust Co., who "advises they have been busy working on this account for some time and that any help you can give them by talking to Gen. Norstad will be greatly appreciated. They have promised us great things if they can get the account," Holmstrom concluded.

Gen. Norstad, in a "Dear Fred" letter to Korth Apr. 15, 1963, said, "your friend, Lynn B. Griffith, has been very helpful to Owens-Corning Fiberglass in the preliminary studies, site selection and other activities connected with the development of the plant in Waxahachie. This fact and your interest will be major factors in determining the company's banking associations in that area." Gen. Norstad signed the letter, "Sincerely, Larry."

C. F. Seabrough, Owens-Corning Fiberglas Corp. treasurer, on July 3, 1963 wrote Korth that his firm had selected the Waxahachie Bank & Trust Co. for the depository of the firm's new plant there. "We appreciate your recommending this bank to us," Seabrough wrote. "I told Lynn that his bank had been strongly recommended by a number of his friends, including you."

Holmstrom on July 19, 1963, wrote Korth: "We had impressed upon Lynn Griffith your participation in obtaining the account of this company for his bank, and he has reciprocated by increasing his balance with us but not to the extent we would like to see it. He has an average balance of about $30,000, but of course his main account is in Dallas.

"As a bit of information, practically every individual I have talked to and at every meeting I have attended this week, invariably the big part you are playing in the investigation is brought up and the fine job you are doing in answering the many foolish questions the committee seems to be asking."

• **Pan American World Airways.** Guy R. Hudson, a junior official with the Bank of Nevada in Las Vegas, wrote Korth on June 26, 1963: "Pan American Airways will be a prime contractor on space projects in the Las Vegas area. I, along with Mr. A. M. Smith, president of Bank of Nevada, would be grateful for any information or assistance which you could render in helping us to establish their local account with us...." On July 3, 1963, Korth wrote William J. McEvoy of Pan American that "I will appreciate your doing what you can consistently do in assisting Mr. Guy R. Hudson in securing the local account." Korth described Hudson in that same letter as "a young friend of mine." Pan American had opened an account with another bank—the First National Bank of Nevada—before the carrier received the letter from Korth.

• **Ling-Temco-Vought, Inc.** J. E. Standefer, nuclear technology manager of Chance Vought Corp.'s Aeronautics and Missiles Div., asked Holmstrom to help persuade Korth to attend a briefing at the plant Mar. 30, 1963, on the Slam nuclear ramjet missile. When this request was denied Standefer on Apr. 10, 1963, wrote Holmstrom asking him if Korth could visit the plant within the next 45 days or if representatives of the firm could visit the Navy Secretary in Washington. On Mar. 29, 1963, Korth wrote Holmstrom that he was "somewhat puzzled" as to why the company went through Holmstrom. In another letter Apr. 15, 1963, Korth reasserted his puzzlement, but said: "I was by Chance Vought about six

Bank Uncertain About Korth's Return

Washington—Spokesman for the Continental National Bank of Ft. Worth said there is no commitment on either side for Fred Korth to return to his job there when he leaves the post of Navy Secretary Nov. 1. Korth was president of the bank until becoming Navy Secretary Jan. 4, 1962.

After acknowledging in Aviation Week & Space Technology that Korth in the past had said he would return to Continental, the spokesman said: "There has been no recent comment from Mr. Korth that he plans to return." If Korth does want to return to the bank, the spokesman said, the request will have to be approved by the Continental board of directors.

Flavors Korth did for Continental while he was Navy Secretary are being cited by many Kennedy Administration officials as the real reason behind his resignation. Korth has denied this (see p. 23). But Administration officials are refusing to confirm or deny publicly the reports that Korth was asked to resign because of the letters he wrote.

Rep. H. R. Gross (R., Iowa) is demanding an official explanation for the resignation. Korth's Navy friends have been distressed about the refusal of the Administration to corroborate his explanation.

Senate Permanent Investigations Subcommittee also plans to ask Korth about some of the letters he wrote before he became Navy Secretary, to show his close ties with General Dynamics winner of the $7 billion F-111 (TFX) contract. One such letter was written by Korth Jan. 11, 1960, to Lambert J. Gross, financial president of GD. After thanking Gross for doubling GD's deposit in Continental, Korth said: "I will, of course, continue my best efforts for the Convair Fort Worth plant and am planning to be in Washington this weekend to talk with some of the members of Congress in the hope of being helpful to the B-58 program."

Korth Denies He Was Asked to Resign

(Navy Secretary Fred Korth Oct. 19 issued a statement denying he was asked to resign by the Kennedy Administration. As part of its detailed coverage of the Senate F-111 (TFX) investigation, Aviation Week & Space Technology prints the full text of Korth's statement.)

I resigned solely for the long standing personal reasons I expressed to the President. I do not, of course, know what the anonymous officials referred to in news stories may have had in mind, but the reasons stated did not and could not have influenced my resignation.

It is possible that the current rumors came from discussions of material secured by the McClellan Subcommittee subsequent to my appearance before that Committee. I did consider whether the continued investigation of the Subcommittee of my personal affairs, having nothing to do with the TFX controversy, should cause me to delay my resignation. I concluded that since there was and could have been nothing of any substance develop that I should proceed with my plans and caused a search of my personal files which might have a bearing on the situation. I placed all of these facts before the Department of Defense and the Justice Department and asked for an examination.

In order to put these rumors to rest and in proof that these activities were not important enough to remain—much less resign in fear of them—I am making copies of all documents and letters known to be held by the Committee available to the press.

These documents and letters were obtained by the Committee in a comprehensive investigation of the files and records of the Continental National Bank of Fort Worth, including an investigation of my personal checking account back to 1953. Contrary to press accounts this investigation did not occur "shortly before my resignation" but over a month ago. Nothing found in these financial records changes, modifies or adds in any material way to the record of the Senate Committee with respect to the TFX award. The Department of Justice has thoroughly investigated these records and has ruled that there was no conflict of interest. The only connection that the Continental National Bank, from which I resigned as President upon assuming office as Secretary of the Navy, had with the successful bidder with the TFX, was that it was the smallest of 20 banks which participated in a fully secured line of credit negotiations by the Chase Manhattan Bank of New York long prior to the TFX competition. Senator McClellan, at the hearings, stated that he saw no special significance in this transaction.

In the course of its investigation, the Committee staff also obtained some personal letters that I had written to friends and former associates at the bank which had nothing to do with Navy business or my official duties.

I am also making available to the press everything found in my own files that is relevant to this matter. These letters do, in fact, show that on several occasions—certainly less than a dozen over a period of almost two years—I wrote personal friends with respect to their business at the bank or in connection with the welfare of the bank. I repeat that not one of these had anything to do with my official responsibilities.

On three occasions, over a two year period, an official of the bank wrote me concerning procurement proposals that friends or acquaintances of the bank official had presented to the Navy. These were handled on an official basis by the Navy as many similar letters were handled from any citizen seeking to do business with the Navy. These are not classified and the full Navy files are available for examination.

Before becoming Secretary of the Navy, I served the U.S. Government in several capacities. I am proud of my record of public service and my entire record, I think, justifies this pride.

With respect to the few instances that showed I continued to show an interest in the welfare of the bank, of which I had been president, I want to emphasize the following points:

None of these instances in any way involved my official responsibilities.

At the hearing on my nomination as Secretary of the Navy, I advised the Armed Services Committee of the United States Senate that I retained my relatively modest stock interest in the bank (it was about 1.7% of the outstanding stock). Incidentally, the financial burden of my service in Washington has been so great that I have had to sell almost all of that stock. I also advised the Armed Services Committee that I hoped to return to my association with the bank on completion of my service with the Navy.

The news media today also have referred to a previously publicized law suit against me and other leading Texans who were directors of All States Life Insurance Co. In the first place, this litigation had nothing whatsoever to do with my government service. The facts involved occured in 1955—seven years before I became Secretary of the Navy. The law suit was filed almost two years before I took office. The obvious attempt to create the impression that this law suit was in some way connected with my public service is completely unjustified.

In the second place, this law suit involved a familiar type of commercial law transaction. Shortly after the formation of the All States Insurance Co., a number of prominent Texas businessmen were offered stock at the original issue price and were invited to become directors. Thereafter, the stock was sold to the public at a higher price approved by the Insurance Commission of Texas. Five years later, a law suit was instituted by a few dissident stockholders. Rather than subject the directors of the company to the harassment of trial, the suit was settled fairly and equitably with the approval of the United States District Court in which it was pending. The final decree stated that "the suit shall not be construed as an admission by the defendants against whom judgment is rendered."

My working day as Secretary of the Navy has customarily commenced before 7 a.m. I have seldom left my office before 7 p.m. Practically every moment has been devoted to the service of my country in the performance of my job. To insinuate that I devoted time or attention to my personal interest to the detriment of my responsibilities is a gross libel. I deeply resent any insinuation that these few trivial incidents and communications raise a question concerning my character or that they furnish or could have furnished a valid basis for my reluctant decision to resign to attend to my long neglected personal and family affairs.

Production F-5A Makes First Test Flight

First production model of Northrop F-5A military assistance program fighter is shown during first flight test over Edwards AFB, Calif. Powered by General Electric J85-13 afterburner-equipped turbojets, the F-5A is fitted with external stores stations for a variety of weapons (AW Sept. 2, p. 27). Note wingtip mounts for Sidewinder air-to-air missiles.

months ago and had a rather complete briefing on the ramjet situation, but I'll be happy to if it would be helpful to you to go by and have them brief me again."

• **Phil Regan's $50,000 deposit.** Korth in January, 1963, entertained Phil Regan, an actor who runs a human relations firm in Palm Springs, Calif., by taking him and his wife out on the Navy yacht Sequoia. At that time, Korth evidently talked to Regan about depositing money with Continental, for this was in the letter Regan wrote to Korth Jan. 21, 1963: "Upon my arrival home the first thing on my agenda is the deposit I promised you. Enclosed you will find a check payable to the Continental National Bank in the amount of $50,000."

Korth evidently felt free to use the Sequoia to entertain bankers. On Aug. 13, 1962 he wrote Holmstrom that it would be "nice" to entertain his friends from Continental on the yacht, and also the bank's "extra good customers."

• **Neiman-Marcus account.** Leon Jordan, vice president and comptroller of Continental, wrote Korth on Sept. 14, 1962: "I note on today's new account list that you have secured a $25,000 account from Neiman Marcus for us and only a few days ago another $25,000 savings account the name of which I don't recall at the moment but suffice it to say that this is probably more business than the people who are primarily responsible for new business have gotten in the past 2 or 3 months..." On Sept. 15, 1962, Korth wrote Stanley Marcus: "I am of course appreciate (sic) of your favoring my former connections..."

• **Inside information.** Kenneth M. Fleet, assistant vice president of Continental, Mar. 19, 1962, asked Korth for "first-hand information" about the Navy's intention to purchase Laguna Shores, a Wherry housing project in Corpus Christi, Tex. On Mar. 21, 1962, Korth replied: "I have advised Jim Wright that the Navy proposes to purchase this project and has recommended such purpose (sic) to the Department of Defense. A decision by the Department of Defense has not yet been passed on to me..." Rep. James C. Wright, Jr. (D.) represents the Ft. Worth area.

• **Opposition to new banks.** Fred Holland, president of the Merchants and Planters National Bank of Shennan, Tex., wrote Korth on Nov. 7, 1962, that a group was trying to get a national charter for a rival bank nearby in Grayson County. "We must have assistance from friends like you if we are to effectively oppose this application," Holland wrote. "I have assured Gus that if we are successful in our efforts that we shall certainly make it worthwhile to his bank..." Korth responded Nov. 9, 1962, that "I shall do everything I can consistently to assist you in blocking what I consider an improper application. I will discuss this matter with the proper people..."

John Q. McAdams, president of the Winters State Bank in Winters, Tex., June 29, 1963, wrote Korth: "Want to thank you as sincerely as I know for the assistance you gave in defeating an application for a national bank in our town. If the opportunity is ever presented for me to show my appreciation for this favor, it shall be my intention to try with determination..." Earlier, on Apr. 29, 1963, Holmstrom notified Korth that McAdams "has increased his account with us substantially, and I am convinced now that if the application for the national charter at Winters could be declined, we would probably get all of his business. Thought you might be interested in having this information."

Navy Probe Studies

Washington—Navy Bureau of Weapons has invited 13 companies to bid on feasibility studies for ship-launched probes using Terrier-boosted two-stage solid rockets as launch vehicles.

The project, called Sea Star, involves launch of small reconnaissance, weather, ferret and communications payloads to altitudes of 700 mi. Launching ship and other ships in the area would then read out data from the probes.

Companies invited to bid on the first phase—program definition—are Avco, Bendix, Ling-Temco-Vought, General Dynamics, General Electric, Goodyear, Hughes, Martin, North American, Raytheon, Republic, Space Technology Laboratories and Radio Corp. of America.

Navy plans to select two companies in January for six-month studies, and plans to select a single manufacturer for the project next July.

Project Forecast Studies

Los Angeles—Some study areas of USAF's Project Forecast (AW Sept. 9, p. 28) have been reopened for further analysis, following the recent briefing here of Defense Secretary Robert S. McNamara and Under Secretary of the Air Force Brockway McMillan by Space Systems Div. and Aerospace Corp. personnel.

Some Project Forecast participants—military and civilian—who were released when the project's sessions were completed have been recalled for the reopened study areas. Approximately 100 planners are engaged in reassessing previous analyses, presumably as a result of suggestions by McNamara and McMillan.

Technical, Ethical Study Slows AF Comsat

Washington—Selection of a contractor for the military communications satellite system has been delayed by Defense Secretary Robert S. McNamara until he assures himself that the choice will not be questioned on either technical or ethical grounds, or that a civilian communications satellite system cannot do the military task.

The satellite is called MACS, for military medium altitude communications satellite. A source selection board composed of Air Force Space Systems Div. and Aerospace Corp. representatives recommended two months ago that the team of Philco and Space Technology Laboratories receive the award. The board selected this team over the General Electric-Motorola team.

McNamara has delayed his decision primarily because of the extended absence of Dr. Joseph V. Charyk, president of the Communications Satellite Corp. McNamara asked Charyk if a commercial satellite would be suitable for military use, and when it can be put into operation. Presumably, he is awaiting a reply before announcing the winner, probably early next month.

From the standpoint of possible conflict of interest, McNamara and his staff are checking and evaluating the Philco proposal to assure that it can withstand the closest public and congressional scrutiny. Philco is now a subsidiary of Ford Motor Co., and McNamara formerly was president of Ford.

Air Force officials close to the project feel it can withstand inquiry, and that the Communications Satellite Corp. will report that a commercial satellite cannot meet military requirements, except for routine transmissions. They base this conclusion on the following military requirements, which will not be included in the commercial system:

- **Jam-resistant voice** and teletype channels for use in war.
- **Provision for transmitting** signals for special applications, such as television and facsimile.
- **Protection against** attack and high radiation.
- **Transmission and reception** in both UHF and microwave bands.
- **Provision for** air and ground transportable stations.

One of the major differences between the two systems is in stations. Commercial system, designed for high capacity communications, will use high power and large antennas, and will be built on foreign soil after diplomatic negotiations. System probably will take three years to put into operation after development is started. A more austere military satellite system could be developed in 18 months, spokesmen say.

Defense Dept. is expected to use the commercial system for routine, high-density messages.

MACS satellites will be considerably smaller than Advent-type communications satellite concepts and will be launched into medium-altitude (5,000-mi.) orbits.

Gravity gradient stabilization may eventually be used in the MACS satellites. This system, consisting of a long retractable boom, a fine wire coil and a weight at the end of the coil, keeps the satellite in one position in relation to a line through the center of the earth so that antenna radiation patterns will be pointed for maximum effectiveness. The satellite is first erected over the magnetic pole by magnetic means, then the boom, coil and weight are deployed.

Gravity gradient stabilization was developed by the Applied Physics Laboratory of the Johns Hopkins University for use in the Navy's Transit navigational satellite system. It failed to deploy in one developmental satellite but succeeded in another (AW July 29, p. 25). Although the principle has been demonstrated in low-altitude applications, the medium-altitude application will require some modification because of the lowered gravity force at 5,000 mi.

Defense Dept. officials want to use the system as soon as possible in MACS. It has not yet been determined whether a separate developmental launch will be tried first or whether it will be tried with the MACS satellites themselves. If the first plan is used the MACS will be spin-stabilized (AW Sept. 2, p. 40).

The Fiscal 1964 military budget request for MACS was a subject of considerable negotiation between McNamara and Congress. Appropriations committees were hard to convince that the project was necessary.

Sources have said that the figure now stands at $99 million for Fiscal 1964. To this will be added the money left from the cancellation of Advent. Some hardware in the form of Advent ground stations could be used in MACS.

New Ranger Delay

Washington—Launch of Ranger 6 has been postponed from December to early next year because some transistor diodes in the spacecraft may be faulty.

National Aeronautics and Space Administration said last week that inspection of samples from a shipment of diodes used in the hard-landing lunar photo reconnaissance spacecraft showed minute flakes of gold bonding material loose inside the diodes. All of the 230 or more diodes in the central computer and sequencer and 12 in the attitude control system will be replaced, although the spacecraft had successfully completed its acceptance testing at NASA's Jet Propulsion Laboratory.

Flight of Ranger 6 is especially crucial since none of the previous five Rangers has been successful. Following the Ranger 5 failure, NASA made an intensive review of the program and recommended more rigorous quality assurance efforts and changes in management of the program (AW Dec. 24, p. 17). The Ranger 6 flight was delayed nearly a year so that a Ranger spacecraft could be tested to destruction.

NASA said the diodes were made by Continental Device Corp., Hawthorne, Calif., which will replace them with silver bonded glass covered diodes.

NASA Budget May Reach $5.3 Billion

Washington—Final congressional approval of a Fiscal 1964 appropriation for the National Aeronautics and Space Administration is still two weeks or more away, and the agency now appears certain to get $5.2-5.3 billion of the $5.35 billion authorized earlier this year.

NASA Administrator James E. Webb and other top agency officials appeared before the Senate Appropriations subcommittee on independent offices Oct. 18 (AW Oct. 21, p. 28) and urged the Senate to restore all of the $250 million the House cut from the $5.3-billion authorization (AW Oct. 14, p. 37).

"We have overcome the Soviet lead sufficiently to permit us to negotiate space matters from a position of strength [and] the main question which faces this committee and the nation is whether we will maintain this effort," Webb told the subcommittee.

Webb indicated that the agency probably will ask for a supplemental Fiscal 1964 appropriation early next year and said the Administration would request a $5.7 billion Fiscal 1965 NASA budget. The original NASA budget request for Fiscal 1964 was $5.72 billion. The NASA administrator advised the subcommittee that NASA spending would level off after Fiscal 1965, "unless the nation decides that the national interest requires... new programs not under way."

Webb also conceded that the first unmanned flight of the Gemini two-man spacecraft, which had been scheduled for mid-December, will not occur until January (AW Oct. 21, p. 29).

Big Lift Tests Army, USAF Flexibilities

Rhein-Main Air Base—Despite intermittent clashes with uncertainties of European weather, USAF and the Army tested their fast reaction capabilities to reinforce from afar during last week's Operation Big Lift. It included an air shuttle of a full armored division and supporting tactical fighter aircraft from American bases to France and Germany in a 72-hr. period.

The move, however, also raised new political qualms in Western Europe as to U.S. intentions and its willingness to help defend the continent in the event of direct attack from the Soviet Union which does not immediately involve the U.S. (AW Sept. 30, p. 25).

Boeing C-135 turbojet, Lockheed C-130 turboprop and Douglas C-118 and C-124 piston aircraft carried across the Atlantic a total of 234 missions with 15,275 troops from the 2nd Armored Division and 498.2 tons of cargo.

The announced objective of Big Lift, largest coordinated transatlantic test to date for MATS, Army and the Tactical Air Command's Composite Air Strike Force (CASF), was to demonstrate the "rapid reinforcement capability" of the U.S. to Europeans, particularly West Germany.

It represented a possible prelude to the withdrawal of a substantial number of American tactical air and ground units from the continent.

Withdrawal of some troops, possibly as many as three divisions, is favored by many in the U.S. and was recommended in August by a subcommittee of the House of Representatives' Armed Services Committee should Big Lift prove successful.

U.S. officials, however, have been reluctant to verify rumors here that such a withdrawal may be one result of Big Lift. Their stand, in perspective, has reinforced opinion that it will, particularly among those who side with French President Charles de Gaulle's belief that the U.S. will not—and could not afford to—become involved in a nuclear exchange with the Soviet Union unless it was subjected to direct attack.

Proponents of this belief view loss of any U.S. servicemen as further substantiation of their opinion.

West German uneasiness, which could lead to a decline in orders placed with U.S. defense industry, was heightened by reticence of top American officials here to witness Big Lift and to add prestige of their positions to the effort.

Air Force Secretary Eugene Zuckert, arriving here in advance of the first airlift aircraft, largely sidestepped the issue during a planeside press conference. He declined to discuss any possible Army reductions, but said that the U.S. hopes to reduce costs of supporting forces abroad. He said the USAF plans "only minor readjustments."

Any such reductions could portend a cut in West German purchases of American military equipment. Those are now based at least in part upon negotiated willingness to help support U.S. defense expenditures in Germany as well as upon quality of items available in relation to those which could be purchased elsewhere, sometimes at substantially lower cost.

Tactically or strategically, the airlift portion of the three day exercise, which began Oct. 22, presented MATS and TAC officials with a major test of capabilities.

The airlift highlighted continued dependence of the U.S. on piston-engine aircraft for a major portion of heavy air mobility requirements—approximately half the personnel flown overseas in Exercise Big Lift went by Douglas C-124 Globemasters.

Although MATS, prior to the exercise, had put pressure on its units to increase aircraft readiness rates only 23 Boeing C-135 Stratolifters, plus three spares, representing better than half the available airplanes, were used. They were the only transports that made two trips in the massive ferrying exercise.

Air Force and Army observers in Texas during the airlift commented that Big Lift was a jet-age concept geared to the pace of a piston-engine fleet.

Big Lift was to enable Department of Defense planners to evaluate:

- **U.S. capability** for rapid, mass-movement reinforcement of NATO forces and subsequent, prompt commitment of these forces to the battlefield.
- **Ability to link-up** a major U.S.-based land force with combat materiel previously positioned overseas and ready for use.

Ground and air aspects of Big Lift meshed smoothly within the time limits imposed as a result of intensive preparations. The operation was not considered as simulating a "no-notice" war emergency condition.

Preparation officially started with notification Oct. 14 that the operation would start Oct. 22. Participants admitted that they had some prior "grapevine" knowledge of the exercise and were able to do some planning.

MATS airlifted the entire personnel of the 2nd Armored Division, stationed here with its 13,336 troops and 153 tons of battle equipment. Another 1,628 troops and 11 tons of equipment of supporting Army units, and 394 airmen and 340 tons for CASF.

They had to arrive in Europe "within 72 hours," to participate in a NATO maneuver against an "aggressor" force, the 3rd Armored Division. CASF, in addition to airlifting personnel and equipment, also moved approximately 120 fighter and reconnaissance aircraft overseas. Air refueling support for two squadrons of F-100s was provided by 45 Boeing KC-135 jet tankers from the Strategic Air Command.

All heavy equipment of the 2nd Armored Division and supporting Army elements was pre-positioned in Germany, drawn from existing stocks. To speed utilization of that equipment, MATS moved some 500 division personnel overseas several days ahead of the troop movement. The advance echelon was responsible for checking out and readying the division's borrowed equipment for movement into the maneuver area.

MATS utilized a mixed fleet of 202 prime aircraft, plus 29 backup planes, to provide 232 sorties from the U.S. to handle the mass troop movement. The actual airlift, using a dozen loading bases in the U.S. and eight off-loading points in Germany and France, was accomplished in 63 hr.—well within the target schedule the Army requested. The Boeing C-135s beat their own schedule by approximately two hours.

MATS' fleet consisted of 96 Douglas C-124 Globemasters, each carrying 80 passengers, 30 Lockheed C-130 Hercules, each carrying 60 passengers, 35 Douglas C-118 Liftmasters, each carrying 57 passengers, 23 Boeing C-135 Stratolifters, each carrying 73 passengers, and 18 Douglas C-133 Cargomasters, carrying 29 tons of cargo.

This fleet, along with backup aircraft, took 355 air crews, for a total of 2,999 flight personnel.

Transport units participating came from McGuire AFB, N.J., Charleston AFB, S.C., Dover AFB, Del., McChord AFB, Wash., Travis AFB, Calif., and Hickam AFB, Hawaii.

TAC aircraft included three fighter squadrons—two F-100 units and one of F-105s. It also had a reconnaissance package of eight RF-101s and six RB-66s. Three squadrons of supporting C-130s also were used. CASF began deploying from home bases to staging areas two days before leaving for Europe.

In addition, 41 SAC KC-135 jet tankers accompanied TAC aircraft on the non-stop high-fly missions to provide in-flight refueling as needed—four each in case of F-100s.

Test of MATS flexibility and its contention that such a maneuver could be executed with minimum warning at any time of year came early.

At 6 a.m. the second day, rolling fog moved into Rhein Main. It cut off all traffic for 4½ hr. Twelve aircraft already had arrived, each with an average of 73 troops and duffle bags.

Of the five aircraft that arrived during the fog four were diverted to Ramstein Air Base in Germany, 1½ hr. away by surface transport, the fifth went to Mildenhall, England.

MATS used a minimum of on-base facilities at each station. It had flown in the required servicing personnel and spares in advance.

One problem was how to operate out of a "bare base" facility with only ramp space and runways available. That meant setting up a complete maintenance and fueling operation with personnel working out of tents.

A bare base was operated by the 62nd Troop Carrier Wing airlift control force which had flown in 200,000 lb. of equipment in the three days before the operation started.

A highlight of the operation was the installation of 50,000-gal. flexible bag fuel tanks which had been airlifted. They were capable of fueling a C-124 at the rate of 500-600 gpm. or three C-124s at 300 gpm.

Ground crews had time to prepare for aircraft and thereby speed maintenance after landing because all arrivals contacted their bases when 150 mi. away to report requirements.

Deployment of forces back to the U.S. will be at a more leisurely pace, with the main body of troops returning before Thanksgiving and rear elements before Christmas.

U. S. May Reduce Forces Abroad

U.S. will give increased emphasis to massive troop deployment by airlift to reduce the number of permanent forces stationed abroad and also to cut defense spending (AW Sept. 30, p. 25). Confirmation of this major U.S. policy shift was given by Deputy Defense Secretary Roswell Gilpatric in a Chicago speech Oct. 19 that had been cleared by both the White House and State Dept.

Both President Kennedy and Defense Secretary Robert S. McNamara previously attempted to allay fears of the West German government that the large Big Lift troop deployment (see story) does not mean a reduction in U.S. ground forces in Germany.

Gilpatric said that large U.S. forces will continue to remain overseas but he forecast cuts with these carefully phrased words:

"Some shifts in the form our military presence has taken in recent decades are beginning to be practicable." Ten years ago the U.S. lacked the means for rapid deployment outside the country, he added.

Operation Big Lift was cited by Gilpatric as a demonstration of U.S. ability to project military power more quickly over greater distances than before. Gilpatric called this air mobility a "multi-base" capability that will help reduce U.S. expenditures overseas.

In his Chicago talk, Gilpatric also cautioned that aerospace-oriented industries must diversify into other fields if they expect to maintain present levels of business activity, because of proposed defense spending cuts. These cuts, and increased reliance on airlift at the expense of permanent overseas forces, were first reported in Aviation Week & Space Technology (Oct. 14, p. 26).

After citing large increases in defense spending from the 1950s to the present, Gilpatric said: "We face another new period in which we can hope for a level off of defense spending for the next several years. There may be . . . some decline in over all defense costs."

He said despite additional costs of military pay raises amounting to $1.2 billion per year, other savings would make a decrease possible. He said the Administration intends to reduce the percentage of the gross national product devoted to defense.

Gilpatric stressed the shifts of military procurement that have caused some companies to seek other than defense markets. This was true when defense spending was rising, he said.

Now, with leveling off or reduction in defense spending the trend will accentuate, and taxes can be lowered, he said.

Lance Mockup Shown With Launcher

Full-size engineering mockup of Army's Lance ballistic missile system, formerly called Missile B, was shown last week at Assn. of U.S. Army meeting in Washington. Lance surface-to-surface missile system, shown in launching position, uses self-propelled, light weight launcher. Missile also can be carried into battle zone by helicopter, or parachuted.

German Vote Breaks Transall Budget Block

Paris—West German Defense Committee reversed its opposition last week to important German credits for the Franco-German common transport project, the Nord Aviation C-160 Transall, and voted approval.

The West German Bundestag recently voted, 14-12, to hold up Transall credits in the 1964 budget until a new evaluation on the Lockheed C-130 Hercules could be made. The government, which already has pumped financing into the prototype and pre-production stages of the Transall project, is slated to buy up to 200 aircraft. The French plan to order 50 (AW June 10, p. 76).

Obviously, if the Germans cut back their Transall investment it will have considerable financial repercussions on the project. Two Transall prototypes already are flying and a third, built by Hamburger Flugzeugbau, is to fly at Hamburg in December. Six pre-production aircraft are under construction.

French officials privately argue that it makes little sense to compare the Transall with the Lockheed Hercules, since the two aircraft are considerably different in size. The West Germans, however, claim it isn't a question of comparing the two aircraft but rather of determining if West Germany needs a larger military transport such as the Hercules. Some Germans also argue that the 1966 operational dates for the Transall require a stop-gap transport program.

In the unexpected reversal, the West German government apparently now has cleared the way for the Transall program to enter production stage. Of the first 160 aircraft planned initially, West Germans will receive 110 and the French will get 50. No decision has been made on how each government will share in production.

STL May Make $1-Million Bonus On Vela Hotel Incentive Contract

Space Technology Laboratories can make a profit as high as $2 million or as little as $77,000 on the Vela Hotel space nuclear detection program, depending on bonuses or penalties the company can earn through satellite performance.

First two satellites in the Vela Hotel series were orbited in a single launch from Cape Canaveral Oct. 16 (AW Oct. 21, p. 30). Air Force says both are functioning normally, as is a piggyback payload, tetrahedral research satellite 4 (TRS-4).

One Vela Hotel satellite has an orbit ranging from 72,000-61,700 mi., with a period of 106 hr. 48 min. The other has an orbit of 72,600-62,300 mi., with a 108 hr. 6 min. period. TRS-4 orbit ranges from 64,300 mi. to 136 mi. The TRS-4 satellite has a period of 38 hr. 49 min.

Cost-plus-incentive-fee contract held by STL is the first sizable government award that can both penalize and reward performance of satellites.

STL's contract with Advanced Research Projects Agency is for production of a prototype Vela Hotel payload and 10 flight satellites for $13.9 million. Normal fee for the contract is 7.75%, or $1,077,000, which can be increased to as much as 14.5%, or cut to 0.5%, depending on performance.

Rewards and penalties specified in the contract include:

- **Incentive of $25,000** for a successful 168-hr. continuous-run reliability test prior to customer delivery on the first attempt. No incentive is awarded if more than one try is required. However, a penalty of $20,000 is levied if the third try is unsuccessful. STL is believed to have successfully completed the 168-hr. test with its first two spacecraft to achieve a total incentive award of $50,000.
- **Early demonstration** incentive fee of $125,000 for successful spin-up, separation and injection into final orbit of the two spacecraft. STL has qualified for this reward.
- **Controllable error** penalty of $10,000 for inefficient launch operations. This clause does not have a corresponding incentive fee but STL was not penalized since the twin satellites were launched within requirements in the STL-ARPA contract.
- **Reward as high** as $100,000 for performance in orbit if both satellites operate successfully for 180 days. Total penalty in the event of unsuccessful operation could be as much as $20,000, effective from time of launch up to 60 days. From the 61st to the 120th day neither penalty nor incentive is awarded. From the 121st to the 180th day, incentive award is pro-rated on the number of successful days of operation, with a maximum of $100,000 possible. For the projected second, fourth and fifth launches, the contract calls for a $60,000-$60,000 split between incentive and penalty.

Incentive award in the third launch is only $20,000, while the penalty is $100,000.

NASA Plans New Look At Electronics Center

Washington—National Aeronautics and Space Administration has named a five-man committee to take another survey of potential sites for its controversial Electronics Research Center, but the industry consensus is that the space agency will again favor the Boston area.

NASA and the Administration were criticized for siting the proposed center in Boston because Congress considered it a political plum resulting from the election of the President's brother, Sen. Edward M. Kennedy (D-Mass.). Consequently, in authorizing NASA's budget, both House and Senate required NASA to make a formal report on site criteria, and then to make another survey of potential locations.

The survey committee will make its recommendations to James E. Webb, NASA administrator, who will report to Congress.

Major criteria in the selection will include competence of graduate schools in area universities, number and quality of industrial electronic research laboratories and availability of qualified scientists and engineers.

In addition to Boston, NASA's original choice for the center, major contenders are expected to include the Chicago area, which has relatively few NASA contracts; California, both Los Angeles and the Bay Area, and possibly even Washington, D. C., and Florida.

The five-man committee includes Francis B. Smith, chairman, chief of instrument research division at Langley Research Center; Wendell H. Pigman, NASA Headquarters, Dr. G. Allan Smith, chief of guidance and control systems branch at Ames Research Center, Dr. B. Richard Teare, Jr., dean of engineering and science, Carnegie Institute of Technology, and C. R. Morrison, director of program support and advanced systems, NASA office of tracking and data acquisition. The committee report will include a general evaluation of the economic impact the research center would have on the area in which it is located.

The space agency says it will give key public officials an opportunity to present additional data for consideration "at an appropriate time." Where practical, this data should be submitted in writing to the NASA administrator.

The final report to Congress by Webb is to detail the reasons for the choice of the geographic location recommended as well as the nature of the research center itself. The House and Senate committees then will have 45 days in which to review the study and indicate any objections.

Industry Studies NASA Procurement List

By George Alexander

Cape Canaveral—National Aeronautics and Space Administration will develop a qualified products list of components and subsystems for launch vehicles, spacecraft and ground equipment and probably will direct prime contractors to seek subcontractors from this competitive list in future procurements.

The impetus for a formal parts prequalification program stems largely from a recent controversy over the subcontracting of Saturn 5 telemetry systems.

The feeling in NASA seems to be that much of this controversy could have been avoided if such a qualified parts list—open to any manufacturer who wanted to gain a position on the list—had been available.

Ernest W. Brackett, director of procurement for the agency, told AVIATION WEEK & SPACE TECHNOLOGY that his office is studying the policy and procedures required for such a list "so that we can treat all companies fairly."

Pre-qualifying of common parts before their actual requirement in any new system is not original with NASA. The Dept. of Defense has had such a program for more than 10 years. Like the DOD program, the NASA list will be open to any manufacturer who submits random samples of his product for independent tests. If the part meets what promise to be stiff NASA specifications, it will be included on the list.

Whether the testing will be done by NASA or outside by independent test laboratories—both methods are used by the DOD—is undecided, Brackett said. To run the test program within NASA would require considerably more manpower, he said. The implication was that NASA might test outside.

Preliminary discussions about the list in NASA headquarters have centered around the carefully planned, step-by-step evolution of the list. The 11 NASA centers probably will be asked sometime within the next several months to identify the most common and most critical parts in their programs and to recommend both test specifications and procedures. Next year, NASA may advise industry of the parts in which it is interested and the list will be started with those selected components.

The list will be built up gradually. Brackett stressed that a listing will be won or lost by a part's performance under test and not by its manufacturer's name. Qualifying parts in advance of their incorporation into a system is said to save both time and money. It also provides higher reliability by starting the development cycle with proven parts.

Industry has mixed feelings about NASA's qualified products list. It welcomes the competitive aspects of the list and the opportunity to demonstrate the excellence of its products.

But sources feel the list forces them to do two "selling" jobs—first, through the test program, to NASA, and then, having gained a place on the list for the part, to different prime contractors.

The Saturn telemetry controversy began last Feb. 1, when a letter from NASA's Marshall Space Flight Center at Huntsville, Ala., was sent to the Boeing Co., North American Aviation, Inc., and Douglas Aircraft Co., prime contractors respectively for the S-IC booster, S-2 second stage and S-4B third stage of the Saturn 5 launch vehicle.

The letter was signed by Oswald Lange, director of what was then the Saturn systems office. It noted that recent meetings with the three firms had indicated the need "for policy direction concerning the standardization of telemetry equipment."

It set the following guidelines for all stage manufacturers to follow:

- **All three companies** would be required to use telemetry equipment identified in late 1962 by the instrumentation branch of the center's astronics division. This equipment was said to be vital to the over-all compatibility of the telemetry systems carried aboard the Saturn 5.
- **Procurement of telemetry** equipment would take two forms—either directed or routine purchases. The documentation for 'directed buy' parts would include a list of 'approved vendors" for each item (see box, p. 30). Prime contractors would seek the needed equipment from the two or three approved vendors. Documentation accompanying the "routine purchase" components would be as detailed, but would not include a list of approved sources. Prime contractors could solicit whatever telemetry firms they chose for these items so long as they met IRIG (Inter-Range Instrumentation Group) performance specifications.

The letter emphasized that responsibility for control of the over-all launch vehicle's telemetry systems would be Marshall's. It closed with the statement that the approved sources list was in final preparation and would be mailed to the three stage manufacturers soon.

The letter caused problems almost immediately. North American's Space and Information Systems Div., which is building the S-2 at Seal Beach, Calif., had begun some preliminary work on the telemetry system's design before the letter arrived. It was "talking" with some regular vendors, the company said. One of these was Sonex, Inc., a small eastern manufacturer of FM-FM subcarrier oscillators.

Boeing, North American and Douglas were aware of the list's existence and

Apollo Parts Interchangeability Sought

Houston—Maximum interchangeability of Lunar Excursion Module (LEM) guidance and navigation system parts, component parts and subsystems with those for the Apollo command and service modules, is goal sought by National Aeronautics and Space Administration in its negotiations with five contractors selected to handle the LEM program.

Similarity of systems in the modules is expected to simplify over-all reliability and utilization of equipment by the astronauts.

Manned Spacecraft Center here will manage development and fabrication of the LEM equipment as well as have management responsibility over the contracts. Five contractors selected by NASA for negotiation on the estimated $60 million LEM navigation and guidance contract and their work areas are:

AC Spark Plug, Milwaukee, Wis., the inertial measuring unit including its precision gyros, navigation base, power and servo assembly, and coupling display unit. AC Spark Plug will also assemble and test the complete system.

Kollsman Instruments, New York, the scanning telescope, map and visual display unit.

Raytheon Missile & Space Div., Sudbury, Mass., the on-board computer.

Sperry Gyroscope, Great Neck, N. Y., the pulse integrating pendulum accelerometer.

Massachusetts Institute of Technology's instrumentation laboratory, Cambridge, Mass., will direct over-all development of the system. Grumman Aircraft Engineering Corp., which is building the LEM, will be responsible for integrating the system into the vehicle.

New Astronauts Chosen for Manned Spacecraft Programs

New astronauts chosen by National Aeronautics and Space Administration bring the total number assigned to manned space flight programs to 30. The new group includes (seated from left) Maj. Edwin E. Aldrin, Jr., USAF; Capt. William A. Anders, USAF; Capt. Charles A. Bassett II, USAF; Lt. Alan L. Bean, USN; Lt. Eugene A. Cernan, USN, and Lt. Roger B. Chaffee, USN. Standing, from left are Capt. Michael Collins, USAF; R. Walter Cunningham, civilian; Capt. Donn F. Eisele, USAF; Capt. Theodore C. Freeman, USAF; Lt. Cdr. Richard F. Gordon, Jr., USN; Russell L. Schweickart, civilian; Capt. David R. Scott, USAF, and Capt. Clifton C. Williams, Jr., USMC.

knew generally which items it contained. North American did not think that the list penetrated down to the level of certain small components, such as FM-FM subcarrier oscillators. Marshall, however, said the list included such parts. As a result, North American reportedly broke off discussions with several vendors.

An oscillator manufacturer protested that the Lange letter and the then-unpublished list of 'approved vendors' represented an unfair intrusion on the part of the space agency into normal subcontracting levels and that it had lost out on a contract as a result.

Apparently this firm was joined by at least one other in protesting the letter and list, because Walter L. Lingle, assistant to Dr. Robert C. Seamans, NASA associate administrator, said NASA headquarters learned of the situation and looked into it "when we started to receive complaints."

A second letter, issued about the middle of March, 1963, was signed by Wilbur Davis, assistant director for procurement at Marshall. It rescinded the Lange letter.

The Davis letter stated the center's position this way: It has been determined that it would be in the best interests of the Saturn 5 program to make use of specific items of telemetry equipment from a list of Marshall Space Flight Center approved sources so that the system of each stage will be compatible with the systems of other stages.

In keeping with this goal of compatibility, the Davis letter continued, the three stage prime contractors were directed to use sources on the list—"whenever practical."

Industry observers consider this phrase to be the critical element in Davis' letter, because it negates the "directed buy" phrase in Lange's letter and admits the directive character of that letter. Marshall, admitting that the Lange letter contained some unfortunate phraseology, insisted that both letters were meant to be advisories.

Lingle, however, admitted that NASA headquarters considered the first letter a directive and the prime contractors are reported to have construed it as such.

Accompanying the Davis letter was the list of approved vendors and equipment, which the Lange letter had said would be forthcoming. Boeing, North American and Douglas were told:

"Use of these sources should lessen your design and test efforts in the development of a stage telemetry system, because these firms have done extensive design and test work on telemetry equipment used by the Marshall Space Flight Center on the Saturn 1 program."

The list has caused resentment and pessimism among the many telemetry manufacturers excluded from it. The great majority of such firms queried by AVIATION WEEK & SPACE TECHNOLOGY for their reaction were unaware of its existence. Some, especially those who have dealt with a particular prime contractor for some time, found out about the letter when they began researching the requirements of a stage's system.

All these excluded firms feel that the list—regardless of how it is presented by the Marshall Center—places them at a competitive disadvantage if only because of the psychological impact it has on the prime contractors in choosing subcontractors.

Harry H. Gorman and Otto A. Hoberg, respectively the deputy director for administration and chief of the instrumentation branch at Marshall, insist that the list is only advisory.

Marshall asked only that Boeing, North American and Douglas include the seven firms among those to be solicited for bids, they said. Gorman and Hoberg also said that the firms on the list were recommended only for the development phase of a stage's telemetry system. The primes are free to seek other sources either for this or for quantity production, they added.

Unlisted telemetry firms find these statements less than reassuring. As one put it: "Nine times out of ten, the firm which gets the R&D contract also gets the production contract."

Manufacturers also noted that in past competitions the bid request almost invariably has stipulated that initial hardware deliveries be made 60 to 90 days after a contract award.

No matter how detailed the drawings and specifications are, they feel, it is almost impossible for a firm which starts out cold to meet that deadline.

There also is a feeling among telemetry companies that the Lange letter revealed Marshall's true desires and the three prime contractors are not likely to ignore it.

Boeing, North American and Douglas were guarded in their comments about the procurement prospects of the situation—in itself an indication that industry's fears are not entirely groundless.

One source said that his company "probably will stick with" whatever firms are selected for the development phase. Another prime said that "for schedule reasons," his company undoubtedly will continue with those telemetry vendors selected for the development phase.

So far, Boeing has only one telemetry vendor under contract, the Brown Engineering Co., for the ground-based portion of the pulse-code-modulated/digital data acquisition system (PCM/DDAS). Brown was one of two firms listed by Marshall for this equipment. North American has five telemetry vendors now for the S-2, but four of the five are providing such equipment as antennas, power dividers and radio-frequency couplers. The fifth, Spacecraft, Inc., is under contract to provide a single-sideband multiplexer and is one of three firms listed by Marshall as an approved source for this particular equipment.

Gorman and Hoberg said that the list of recommended vendors is justified because of the money and technical effort invested by the Marshall center in the research and development of telemetry components over the last several years. If Marshall issued only the specifications of the equipment, Hoberg said, industry would have to embark on a research and development program which would duplicate practically all of the center's in-house work to date, would take considerably more time in development and increase significantly the total cost to the government.

Another compelling reason for making maximum use of the knowledge and experience gained by the Huntsville laboratories, Hoberg said, is the fact that there will be only three research and development flight tests of the Saturn 5 launch vehicle, according to present plans. Hoberg said that NASA cannot afford to lose more than a fraction of one percent of the data to be telemetered back on the performance of each of these vehicles. To preclude data losses through equipment failure, interference or incompatibility, the center has striven to develop reliable equipment which operates in harmony with other similar equipment. Now, Hoberg said, the center wants to see this hardware used. Firms which Marshall recommended to Boeing, North American and Douglas have all supported the center under contract, according to Hoberg, in the "design and development, lab testing and verification, building of subassemblies, qualification testing and packaging of telemetry components and systems for the Saturn vehicle." Some contracts—such as Chrysler's and Brown's—go back as far as 1958-1959.

The seven "approved vendors" entered the picture when Marshall could not or decided not, to carry a particular line of development further, one source claims, and so wound up in a position to reap a large part of an estimated $49 million in airborne and ground telemetry systems.

Critical Telemetry Items Cited

Cape Canaveral—These are the items of telemetry equipment judged to be critical with respect to compatibility by the Marshall Space Flight Center and the seven firms recommended by Marshall to Boeing, North American and Douglas as "approved vendors" for this equipment:

- Telemetry calibrator—Avco Corp., Cincinnati, Ohio; Brown Engineering Co., Huntsville, Ala.; Chrysler Corp., Space Div., Huntsville, Ala.
- Single sideband/FM airborne equipment—Avco, Ortronix, Inc., Orlando, Fla.; and Spacecraft, Inc., Huntsville, Ala.
- Single sideband/FM ground portion, double modulation—Avco; Dynatronics, Inc., Orlando, Fla.; Lenkurt Electric Co., San Carlos, Calif.
- 270-channel time division multiplexer, main package—Avco and Brown.
- 270-channel time division multiplexer, remote and high level—Avco and Brown.
- 270-channel time division multiplexer, remote and low level—Avco and Brown.
- Pulse code modulated/digital data acquisition system (PCM/DDAS), airborne—Avco and Brown.
- PCM/DDAS, ground—Brown and Chrysler.
- Remote digital multiplexer—Brown, Chrysler and Spacecraft.
- On board and ground FM/FM telemetry transmitter—Avco, Brown and Chrysler.

Telemetry Production Bid Deadlines

Cape Canaveral—National Aeronautics and Space Administration expects the specifications for the following major telemetry equipment of each stage of the Saturn 5 launch vehicle to be ready for competitive production bids by these dates:

- Airborne calibrator—Dec. 1, 1963 and Feb. 1, 1964.
- Airborne vibration multiplexer—Jan. 1, 1964.
- Power amplifier—Apr. 1, 1964.
- FM/FM (frequency modulated) transmitter—June 1, 1964.
- 270-channel time division multiplexers—Apr. 1, 1964.
- Single sideband FM/FM transmitter—Oct. 1, 1964.
- Pulse code modulated/digital data acquisition system—Jan. 1, 1965.

There is considerable concern among telemetry companies, however, that the bulk of these contracts will go to seven firms recommended by NASA's Marshall Space Flight Center. Some of these seven firms already have been taken on by the primes to help in the detailed design phase of the stage systems' development. Indications are that they will be retained for the later production phase.

Marshall estimates that the Saturn 5 telemetry procurement will cost about $25 million for airborne equipment (excluding auxiliary items such as antennas, matching networks, power sources and distributors) and another $24 million for ground and test equipment.

Dual Comsat Proposal Requests Expected

Parallel requests for proposals for a medium-altitude and a synchronous-altitude communication satellite are expected to be issued to industry in November by Communications Satellite Corp. Probability is that only the medium-altitude satellite will be developed initially.

Reliability will be underscored strongly in the development of the satellite components. Communications Satellite Corp. officials even are considering advisability of a clause in the development contract which would impose responsibility for costs on the contractor if the satellite fails to function or introduce a penalty to absorb part of the cost of the booster if it successfully injects the satellite into orbit and the satellite fails to function thereafter. Indications are that industry will protest strongly the application of such provisions.

Likelihood is that the gravity gradient technique will be used for stabilization of the satellite because of the need for the additional gain of a directional antenna. Communications Satellite Corp. does not intend to conduct its own gravity gradient stabilization development but will rely on Air Force and NASA developments (AW Sept. 2, p. 40) in this field.

House Unit to Approve Four-Year Term for JCS; Veto Threatened

By Richard G. O'Lone

Washington—House Armed Services Committee is expected this week to approve a bill setting the terms of members of the joints chiefs of staff at four years—legislation that is already threatened with a presidential veto (AW Oct 21, p 25)

In an effort to meet at least one of the Administration's strong objections to the measure, an armed services subcommittee headed by Rep F Edward Hebert (D-La) altered the proposed legislation to provide for reappointment of a JCS member for another four years during war or "national emergency declared by Congress" The original measure barred reappointment after a single four year term

Present law allows the chiefs of staff of the Army and Air Force, and the chief of naval operations, to be appointed for a period of up to four years The custom in the recent past has been to appoint for two-year periods The Marine Corps commandant is already appointed to a four-year term

Rep Hebert made it clear that the intent of the legislation goes beyond the fact of a two-year or four-year term that it reflects the continuing dissatisfaction of Congress with Administration and Pentagon policies At one point during the hearings Rep Hebert said "I want to limit the powers of the Executive, and every chance I get I am going to do it"

Backers' Contention

Backers of the legislation, which is co-sponsored by House Armed Services Committee Chairman Carl Vinson (D-Ga) and Rep Leslie C Arends of Illinois, the committee's ranking Republican, contend that a two-year or indefinite term inhibits a chief from speaking out on controversial issues

During subcommittee hearings, members repeatedly cited the cases of Adm George W Anderson, former chief of naval operations, and Gen Curtis LeMay, Air Force chief of staff, both of whom opposed Defense Secretary Robert S McNamara in the selection of General Dynamics Grumman for the $7 billion F-111 (TFX) tactical fighter contract (AW May 13, p 26) Adm Anderson was not reappointed, and Gen LeMay received only a one-year reappointment

Deputy Defense Secretary Roswell L Gilpatric in testifying before the subcommittee, denied that the two-year term custom inhibited JCS members, and claimed that a mandatory four-year term "will place an undue restriction on the appointive powers of the President, with particular reference to his responsibilities as commander-in-chief of the armed forces"

Gilpatric also offered an elaborate argument against pinpointing the TFX controversy as the reason for the action taken in the cases of Adm Anderson and Gen LeMay

This brought a remark from Rep Charles E Chamberlain (R-Mich) that occurring at the time it did, it left me with a very definite impression that Gen LeMay had a trip to the woodshed" Rep W G Bray (R-Ind) said "I don't like for you to think I am naive and for anyone to question that Adm Anderson wasn't relieved or refused reappointment because of the TFX matter certainly believes the audience is naive"

In backing up his argument that a short term inhibits JCS members, Rep Hebert cited the case of the USAF-North American RS-70 a reconnaissance-strike version of the B-70 Mach 3 bomber He said the joint chiefs at one point were unanimously in favor of the RS-70, and then Gen Lyman L Lemnitzer, JCS chairman "was taken out of the picture Gen Maxwell D Taylor was put in and he overruled the other three So that is a classic case"

He added that "it was like pulling teeth to document the position of the joint chiefs of staff in the RS-70"

Rep Frank J Becker (R-N Y) said that while JCS members testified in favor of the nuclear test ban treaty (AW Aug 26, p 29), "I have never heard a more reluctant support in my life In fact, the reluctance seemed to be so great that it overshadowed any reason they might have given for supporting it"

Gen Nathan F Twining, former USAF chief of staff and JCS chairman, said that if he had been appointed for four years, he would have been "more relaxed" and more likely to take a stand on controversial issues He said the two-year term was like having "the sword of Damocles" hanging over his head

Adm Arleigh A Burke, chief of naval operations from 1955 to 1961, testified that the two-year term occasionally had stopped him from speaking out on a controversial point In addition, he said, the short term tends to keep a JCS member from initiating programs he considers necessary, because "he doesn't want to commit his successor" to them

No Reorganization

He never reorganized the office of the chief of naval operations, he said, because "each time I thought well I have only got two years, and there is no need of starting this because my successor may not agree with me"

Gen George H Decker, former Army chief of staff, said two-year appointees have "influenced only about six months of the budget they will operate under," and have little or no influence on long-range planning

Gilpatric commented that under a four-year term if the President wanted to make a change, he would have to fire or reassign a JCS member, and "his removal or reassignment is bound to carry with it a connotation of executive displeasure or reprimand"

In answer to this argument, Rep Bray said that when Gen Douglas MacArthur was fired by President Truman "it didn't wreck his career in fact, Congress gave him a medal"

Gen Twining said "if I had served two years and gone out I would have been a very unhappy man and would have thought that I hadn't done a good job for my service"

Cosmos 20 Launched

Moscow—Cosmos 20 was launched by Russia from the Tyuratam complex on Oct 18 in what the Soviet news agency Tass described as a program of continuing space research. Initial elements announced were apogee 186 mi., perigee 123 mi., and inclination 65 deg

In addition to its scientific instrumentation, Tass said, Cosmos 20 carried a radio transmitting on 19.995 mc

Soviet tracking ships had left Russian ports the week of Oct 7, leading Western observers to predict a launch the following week (AW Oct 14, p 25)

Lunar TV Proposal

Pasadena, Calif.—Competition is being held by Jet Propulsion Laboratories for a study of the ground data handling equipment necessary to process TV pictures returned to JPL's space flight operations facility from its Surveyor lunar lander Proposals for the $250,000 study are due at JPL by Nov 12

Organizations which attended a recent briefing include Bissett-Berman Corp, Automatic, Columbia University, General Electric, General Dynamics General Precision, Hallicrafters, Itek, International Telephone & Telegraph, Hughes Aircraft and Minneapolis-Honeywell

Garrett, Signal Propose to Merge After Curtiss-Wright Raises Offer

Los Angeles—Garrett Corp, conceding that a new offer by Curtiss-Wright Corp to buy a major share of its stock probably would have been successful, offered shareholders an alternative last week by agreeing to merge into Signal Oil & Gas Co as a wholly owned subsidiary

Curtiss-Wright later said its offer to buy 700,000 shares of Garrett common stock at $57 a share (AW Oct 21, p 30) would not be affected

Curtiss-Wright's offer ends Oct 31 and will not be renewed, according to T Roland Berner, board chairman and president Berner said that neither Garrett nor Signal stockholders could vote on the proposed merger until after the C-W offer expires

Thus Garrett shareholders still must choose between selling to C-W for $57 a share, or a merger in which shareholders would receive in a tax-free exchange, stock worth an estimated $60 a share based on current values Prior to the original Curtiss offer in mid-September (AW Sept 16, p 39) to buy approximately 47% of Garrett's outstanding stock, the price was about $42

Terms of the merger would give Garrett shareholders one share of new convertible preferred stock to be issued by Signal for each share of Garrett common stock. This preferred stock would have a fixed annual dividend rate of $2 40, compared with the current $2 rate being paid by Garrett

Each share of the new Signal preferred stock could be converted into two shares of Signal Class A (non-voting) stock The new shares will be callable at $65 after three years and will have a liquidation preference of $60 a share Signal Class A stock, traded on the American Stock Exchange has ranged between 31¾ and 25 in 1963

One factor prompting Garrett management to press for the Signal merger was the shift in brokerage house opinion following the $57 offer Major houses such as Merrill Lynch, Pierce, Fenner and Smith advised against the original $50 offer Merrill Lynch, however, later told Garrett shareholders to "carefully weigh" the $57 offer Merrill Lynch now is advising its customers to decide for the merger, forecasting that the Signal convertible preferred should sell for around $60 vs the $57 C-W is offering

According to Garrett and Signal officials, Garrett would become a wholly owned subsidiary of Signal and would operate autonomously with its own board of directors and officers

Signal Oil and Garrett would each have representatives on the other's board of directors, but the exact numbers have not yet been determined The combined companies have annual sales of $633 million, of which Garrett accounts for $225 million Both are based in Los Angeles, while C-W's home office is in Wood-Ridge, N J

A two-thirds vote of approval by shareholders of each company is necessary for the merger to take place Special meetings for the voting have not yet been scheduled In order for C-W to block the merger, therefore it would have to receive tenders of more than one-third of Garrett's stock, or approximately 498,000 shares of the 1,494,000 outstanding

The merger agreement follows an Oct 10 announcement that Signal had acquired over 100,000 shares of Garrett's stock in the period following the C-W original offer Signal stated that it was continuing to buy the stock

Signal long has been interested in diversifying itself outside the oil industry It now holds 48 2% of American President Lines, Inc, common stock and 11% of the shares of Continental Device Corp, a semiconductor manufacturer of Hawthorne, Calif

Garrett said it will proceed with its legal suit against C-W It plans to seek a preliminary injunction next week to block C-W's proposed purchase Garrett has complained in the U S district court at Los Angeles (AW Sept 30, p 33) that the purchase would violate section 7 of the Clayton Anti-Trust Act

While C-W has stated that its intended purchase of Garrett stock was for "investment purposes," Garrett management charged, following the $57 offer "We believe it is now clearly evident that previous Curtiss-Wright announcement concerning their intention to buy Garrett stock for 'investment purposes only' is an outright misstatement of the facts"

Improved Minuteman

Air Force is planning to flight test a Minuteman ICBM of the present operational configuration but employing a single-nozzle second stage using liquid injection thrust vector control, similar to Improved Minuteman's second stage

USAF will flight test the complete Improved Minuteman configuration next year It differs from the present Minuteman in that it has a lighter and more accurate guidance and control system (see p 70) and the liquid injection second stage

Hurricane Threat

Cape Canaveral—Hurricane Ginny forced USAF and the National Aeronautics and Space Administration to lower a Titan 2 and the first stage of a Delta vehicle from their stands here last week as a precaution Left standing, however, were an Atlas with an ABRES (Advanced Ballistic Re-entry Systems) nose cone, an Atlas-Centaur and a Saturn SA-5

News Digest

Jet Propulsion Laboratory has selected General Motors Defense Research Laboratory, with Radio Corp of America and Bendix Systems Div of Bendix Corp, to conduct parallel, six-month, first phase studies on the feasibility of a lightweight lunar roving vehicle (AW Sept 30, p 23) The contracts are not to exceed $200,000

On Mark Engineering Co, Van Nuys, Calif, received a letter contract from USAF last week for approximately $5 5 million to begin work on modernizing and modifying 40 B-26 aircraft (AW Aug 26, p 23). Contract eventually is expected to total more than $12 million

Walter C Williams, deputy director for mission requirements and flight operations at Manned Spacecraft Center, will become deputy associate administrator for manned space flight operations at National Aeronautics and Space Administration headquarters on Nov 1

Aveo Corp received a $15 5-million USAF contract to continue development of a low observable re-entry vehicle (LORV), to be tested as part of the advanced ballistic re-entry system (ABRES) program

Louis G Dunn will become a vice-president of Aerojet-General Corp, in charge of the company's Sacramento, Calif, plants, effective Nov 1, succeeding Robert B Young who is joining NASA's Marshall Space Flight Center as director of project and industry operations Dunn was board chairman of Space Technology Laboratories

Apollo command module earth landing system has been qualified for a low altitude abort test in early November at White Sands, N M The three-chute system, developed by Northrop-Ventura, successfully landed a boiler-plate command module dropped apex end first from a C-133 at El Centro last week (AW Oct 21, p 28) A drogue chute righted and stabilized the module prior to deployment of the main chutes

Trans World, Continental Discuss Merger

Hughes Tool Co. holdings, relationship of voting trust to control, to be settled before agreement is reached.

By L. L. Doty

Washington—Possibility that Hughes Tool Co. will sell at least part of its holdings in Trans World Airlines to Continental Air Lines as a prelude to a merger between the two carriers grew stronger last week.

The question about the relationship of a "voting trust" to actual "control" remained to be settled before a firm agreement could be reached.

As of late last week, it appeared that the Civil Aeronautics Board reluctantly had been pushed into investigating the control issue as it relates to the Federal Aviation Act of 1958. The control problem was raised again last week in a CAB decision on the purchase of $30 million of TWA debentures. In this decision, Toolco won a minor technical round.

First sign that Hughes was interested in disposing of at least some of his holdings came when Toolco advised TWA last month that it would make a public offering of $80,962,000 in TWA 6¼% subordinated debentures owned by Toolco. The sale of $30 million TWA debentures to Hughes was directly related to a refinancing program undertaken earlier this month by TWA involving a $100 million credit with a group of banks.

Howard Hughes is the sole owner of Hughes Tool Co. which, in turn, owns 78% of TWA's outstanding common stock. The stock is now held in a voting trust to which TWA's present management is responsible.

Previous informal bids for Hughes' 5.2 million shares of TWA common stock reportedly have been made by at least one airline and several firms unrelated to aviation. These bids are said to have been rejected.

Now, however, the recently increased value of TWA's common stock listings on the New York Stock Exchange—a 1963 low of 10¼ versus a 27¼ high—has presumably made a sale more attractive to Howard Hughes. Debentures have climbed from a 1963 low of 70¼ to 99¼.

Although Continental last week refused to comment on the sale, the carrier's president Robert F. Six, has been actively proposing several merger plans involving his company during the past few years. In addition, Continental has been approached with a merger plan by both Toolco and TWA's present management but conditions of each differed widely.

Reportedly, the Continental plan calls for the filing of all stock that the airline would own in a voting trust, with Continental retaining only the right to vote on a proposed merger pending the approval of such a merger by the CAB. In addition to getting Board approval for the merger, the parties to the transaction must get some ruling as to what freedom a voting trust has in negotiating a merger agreement, or where actual control lies.

There have been several cases before the Board in which some factions have held that a transfer of stock to a voting trust does not legally constitute a transfer of control. In the order approving the sale of the $30 million debentures to Toolco, the Board vacillated on the control issue but reached a decision that obviously favored Toolco's views on control. Toolco said that the original order granting it control of TWA, issued in October, 1944, required that any transactions involving more than $10,000 annually must have Board approval.

Toolco reasoned that this "control" order specifically applied to the debenture transaction and that it thus needed Board approval. TWA held that no such approval was necessary. It charged that the CAB has no jurisdiction in the debenture transaction because Toolco lost control of TWA with the establishment of the voting trust. The stands drew the battle lines clearly in the control vs. voting trust issues.

The Board, in its final order, admitted that the original order once had been modified to permit TWA to consummate an extensive refinancing program, and then added that "we do not find Toolco's further acquisition of TWA's debentures with voting stock conversion rights to be adverse to the public interest . . ." It concluded:

". . . we find no reason to pass upon TWA's contention with respect to the control issue," and then denied TWA's request for dismissal of Toolco's motion that Board approval for the purchase of the debentures is required.

The Board thus cautiously eased itself through another case in the control issue, but it now appears evident that it will be forced to make some ruling on this subject shortly. It eluded the issue in the now defunct Pan American-TWA merger plan by deferring hearings in the case. A new merger proposal involving TWA, such as that being proffered by Continental, will again bring the issue into the spotlight.

In addition to the Hughes holdings, there is other stock available. Hughes will sell his stock purchasing warrants with the block of subordinated income debentures which, with other warrants, represent some 2.7 million shares. TWA also has filed an incentive stock option plan for key employes with the Securities & Exchange Commission involving 330,000 shares to be offered at 20¾ per share.

About 1.5 million shares of TWA common stock are now held by the public.

Debentures to be sold by Hughes will be offered in $1,000 units with warrants for 27 shares of TWA common stock. Public sale will be made through a group of underwriters headed by Merrill Lynch, Pierce, Fenner & Smith.

The TWA bank credit of $100 million will be on a revolving basis until December, 1966.

From then until December, 1970, it will be on a fixed four-year quarterly installment basis.

In its filing with SEC, TWA said that $154.3 million is yet to be paid on its $177.7 million jet financing program. To meet this obligation, TWA will offer $27 million in Series B sinking fund notes next year. This, coupled with the bank credit and the $30 million debenture sale to Hughes together with $15.7 million from conditional sale arrangements, will serve as the basis of a refinancing program.

Hughes is not likely to make any move at all on disposal of his stock until the debenture sale has cleared Securities & Exchange Commission registration.

Any revelation of such a plan could run afoul of SEC regulations governing registration and could tie up the debenture sale.

At least one financial group in New York is strongly interested in the TWA stock, and might be a source of capital for Six—or a possible competitor for the purchase.

Helicopter Crash Cause Pinpointed

New York—Metal fatigue which caused the failure of a quill shaft in the rear transmission box was blamed last week by Civil Aeronautics Board investigators for the fatal crash of a New York Airways helicopter Oct. 14 at Idlewild airport (AW Oct. 21, p. 39).

The airline's three remaining Boeing-Vertol V-107-2s remained grounded for possible modifications.

The CAB's preliminary report said the failure of the horizontal quill shaft caused the rear rotor to become unsynchronized with the front rotor and the two, turning in opposite directions, collided. Portions of the front blade were found 3,500 ft. from the point of impact.

The quill shaft is 6 in. long, hollow and with a gear arrangement on each end. It is held in place by a floating pin around which, the CAB investigators said, the fatigue crack began.

Periodic maintenance and overhaul of the transmissions was done by Boeing-Vertol at its Morton, Pa., factory, according to New York Airways.

CAB reported that the transmissions from the other three V-107-2 aircraft of NYA had been removed and sent to the factory for inspection.

This was the second time that the power transmission system in the V-107 has been scrutinized. The main power transmission shafts on the New York Airways V-107s were strengthened by shot peening last year (AW Oct. 29, 1962, p. 52) and given a life of 1,500 hr. for the rear shaft and 2,500 hr. for the front shaft.

Somali Will Receive Direct Soviet Service

Moscow—Somali will become the seventh country on the African continent to receive direct air service to the Soviet Union under an agreement signed last week.

Tass, the Soviet news agency, said the service would link Mogadiscio, the Somalian capital, with Moscow via Cairo and Khartoum. The agency said Il-18 transports would be used, but the date of the first flight was not announced.

Tass also said Moscow-Karachi flights would start in mid-November with Il-18s or Tu-104s, landing at the Pakistani capital on a once-a-week basis.

Concorde Nose Mockup Shown at Filton

British Aircraft Corp. has entered advanced construction on the mockup of a new nose section for the Concorde supersonic transport. New nose, shown above at Filton Works of Bristol Aircraft Corp., is droop-snoot type similar to the Fairey Delta 2. Nose can be lowered to improve visibility during taxiing, takeoff and landing. First photo (below) of Concorde cockpit mockup shows general similarity to cockpits of current subsonic jets. Map presentation, center, is flanked by radar. Flight engineer panel, right, is shown in relation to pilot positions. Using a screen forward of the mockup, the pilot can observe simulated attitude on landing glide slope and while taxiing. Mockup can be positioned hydraulically. It is not known if the new nose section includes retractable visor system on main Concorde mockup (AW Sept. 9, p. 40).

Industry Urges U.S. to Revise SST Plan

By Robert H. Cook

Washington—Administration blueprints for the supersonic transport development program may be forced to undergo drastic revisions in the wake of strong criticism from airlines and manufacturers last week before the Senate aviation subcommittee.

Burden of the testimony has been that the government must assume the full $1 billion program development cost or face the prospect of losing a worldwide market to the subsidized competition of the British-French Concorde (AW Oct. 21, p. 38).

Carriers complained that the FAA-managed program is too specific in detail, its production guidelines impractical and costly, and the policy of assigning delivery of the aircraft "premature and confusing."

Sen. A. S. Monroney (D.-Okla.), after listening to airline opinions that the $250 million estimated industry share of the development cost was too high, and that airline royalty repayments should be discussed at a later date by FAA, agreed that all phases of the cost-sharing formula should be a matter of negotiation between the manufacturers, FAA and the airlines rather than any predetermined formula established by the agency.

Clarence D. Martin, Commerce Dept. under secretary for transportation, reminded the subcommittee that present provisions call for the program's reduction, restriction or termination unless the industry shares in the cost, but later added that it would not necessarily be abandoned if manufacturers do not agree to the 25% participation clause.

NASA Criticized

National Aeronautics and Space Administration also was criticized by Sen. Monroney for its "lack of emphasis" on aircraft development as compared to space.

"You keep talking about pressing problems in space," he declared. "Well it's damned pressing in aeronautics and we must either mobilize NASA's power in this project or go to outside manufacturers and researchers."

James E. Webb, NASA administrator, replied his agency is placing more emphasis and funding in this area and that NASA feels the supersonic development program should be extended "at least another year or longer" beyond its 1970 termination date in order to produce a better aircraft.

Dr. Jerome B. Wiesner, director of the Office of Science and Technology, advised that no attempt should be made to settle on a speed for the supersonic transport until the program is well beyond phase I when prime airframe and engine contractors have been selected.

American Airlines President C. R. Smith warned that the airline industry has not yet paid for its current subsonic jet fleet and he urged that the government pay the entire development cost of the supersonic transport.

"A wise government will not ask a businessman to assume a project of such monumental size that if it fails of success his business enterprise will be left bankrupt. The costs which the supersonic transport is certain to run up during ... development are far beyond the resources of any one manufacturer, or any possible combination of manufacturers. If the government is not willing to take on the development costs, then the project will fail," he said.

Smith said he feels FAA's program should be changed to give the entire project to one manufacturer with the responsibility to produce a prototype. Under the present system of FAA supervision of the design and manufacturing, this "design by committee" could result in a "colossal failure" from which the government will not recover its money and the aircraft will not be profitable for operators.

A more sensible suggestion, and less costly to the government, would be to give a manufacturer, or partnership of manufacturers, a contract to design, build and test fly a prototype aircraft, he said.

Smith emphasized that quality of the aircraft rather than its price is most important, since his company has no enthusiasm for "putting money into a plane that can not support itself." He contends that two separate models of the supersonic transport are needed, rather than one as proposed by FAA. One model would have a larger fuselage for domestic service, and an international model would have the same wings and engines, but lower capacity.

American has placed an order for six U.S. transports and four Concordes, but Smith noted the Concorde order is "just an option to buy." No U.S. carrier has actually bought the Concorde, he said. FAA's plan to establish delivery positions on the U.S. supersonic transport is "premature and ill advised," he said.

United Air Lines generally supported American's stand that a domestic supersonic transport should be designed in addition to the long-range version, and that thorough testing of a prototype aircraft will be necessary before manufacturers can invest heavily in tooling for production aircraft.

United could use six to 10 supersonic aircraft on its transcontinental and Hawaii routes, according to President George Keck. Estimated $25 million price of the aircraft would not be too high if it can operate at a profit, he said.

However, W. C. Mentzer, engineering vice president for United, told the subcommittee there is not enough information on either the Concorde or U.S. transport on which to predict operational costs. He added that he doubted either aircraft would operate at the same seat mile costs as today's subsonic turbojets.

Charles C. Tillinghast, Jr., president of Trans World Airlines, found the supersonic transport program more of an economic than technical problem. Projected seat mile costs on the aircraft are high, he said, and "no one is confident that when the technical problems are solved we'll get the seat mile costs as low as they are today."

Technical Superiority

The $10 million price of the Concorde, under a government subsidy of $450 million, plus lower labor rates, may enable the foreign aircraft to offset the "expectedly superior" advantages of a U.S. transport, he said. The technical superiority of the U.S. aircraft may be insufficient to counterbalance, economically, "the tremendous difference in price."

For that reason, TWA feels the U.S. program should concentrate upon only one minimum size transport suitable for East Coast to Europe flights. The FAA design range of 4,000 mi. is about correct, he said, and designing for more range or constructing a larger aircraft, would cost too much, take too long, and aggravate the sonic boom problem.

As with the subsonic aircraft, speed of operation could introduce new problems of over-capacity of seats, Tillinghast said. New government regulations may be required to prevent this problem in the introduction of the supersonic aircraft.

"With $20-$30 million in these aircraft, it would be a tragedy to fly half empty while we try to outdo each other with supersonic schedules," he explained.

Tillinghast said he favors full government support of the program, since a country that has spent "billions of dollars in space exploration" and has subsidized its merchant marine for

years, "should not balk" at keeping air transportation competitive with Britain and France.

Tillinghast feels the British-French combine is building the Concorde and controlling its own delivery positions in a deliberate effort to delay U.S. entry into supersonic competition and gain a stronger position for European carriers.

As an example, he noted that one week before the hearing, TWA inquired about purchasing the Concorde, but was told it could order only four. The combine refused to negotiate for more than that number and indicated it might refuse to deal with TWA in order to advance the interests of European carriers. Tillinghast said that TWA still does not know whether the Sud Aviation-British Aircraft Corp. combine will continue to negotiate.

Pan American's order for six Concordes had already been accepted last June, he said.

If the airline is unable to obtain Concordes and a U.S. supersonic program is delayed too long, TWA would be in a serious position, Tillinghast said. The airline could "survive" for one year if a U.S. program were advanced, but a two-year delay would place it in a severe competitive position, he said.

Current delivery schedule on the Concordes covers 18-24 months for 18 aircraft ordered by Air France, British Overseas Airways and Pan American, he said.

In comparison, the U.S. tentative delivery rate is 2½ aircraft per month.

Pan American, which has placed a tentative order with FAA for 15 U.S. supersonic transports, urged that the government go forward with a much larger aircraft holding 200 or 220 passengers, "the more the better."

Harold Gray, Pan American vice president, noted that Pan American considers itself as a "tool of the United States government" to build airline service abroad.

The U.S. program should initially be directed at building an international model supersonic transport, after which a domestic model may be developed possibly through modifications requiring no government support, Gray said.

Airlines would probably wait for a superior supersonic transport as they did with the Boeing 707 and Douglas DC-8 subsonic jets, he said.

The U.S. design needs a speed only slightly superior to the Concorde, but a far greater range than the current 4,000-mi. FAA proposal, Gray said. It should have a range of New York to Rome or New York to Moscow, 4,293 and 4,660 stat. mi., respectively.

Alitalia could not avoid buying such a U.S. supersonic to remain competitive, or in reverse if Russia had a Moscow to New York nonstop aircraft, Pan American would likewise be forced to buy the Soviet aircraft, Gray said. Such an aircraft would be large and would probably require the extensive use of titanium in both the airframe and engines. It should have better subsonic performance than the Concorde, since many trunk carriers will have to operate over short routes and densely populated areas where supersonic flight may be restricted. Gray suggested the variable sweep wing may be necessary to accomplish this objective. Engines should not be "hurriedly beefed up" versions of subsonic engines but specifically designed for supersonic flight with prospects of 4,000 hr. between overhauls.

John Stack, vice president of Republic Aviation Corp. and former NASA supersonic transport designer, voiced much of the industry's concern over the cost of the program and the need to concentrate upon an initial prototype.

Since the manufacturing industry has no guarantee of how many supersonic transports will be built, and therefore little on which to evaluate the level of cost sharing, Stack suggested the method employed on the Concorde program.

Financing of the Concorde through prototype and flight certification is being handled by the two governments without any provision for airline royalty paybacks, he said. There have been estimates that the market can absorb 200-250 U.S. supersonic transports.

Stack also urged 100% government funding of a prototype with an increase in planned royalties to the government on each aircraft sale.

North American Aviation, Inc., one of the companies answering FAA's request for proposals, highlighted the financial problems of the industry by pointing out that airframe manufacturers' program expenditures could reach $1.5 billion by the time the aircraft is certificated.

Noting the FAA's "escape clauses" in the program, J. L. Atwood, president of the company, said that if the Administration considers the program commercially unfeasible upon completion of the development program, manufacturers could face a loss of $950 million, even after government participation in the costs.

Again, if the program is abandoned after 100 hr. testing of a prototype, the loss could amount to $500 million.

These figures assume the manufacturer has not exceeded his original cost estimates which he must project over a five-year period, under the FAA program in January, 1964, he added. The chance of experiencing cost overruns that would not be covered by the government is a real possibility, he pointed out.

"Our analyses to date point to immense consequences which a company might not survive if there should be a significant setback in one or more of the principal factors which will determine success," he said.

Atwood said the industry is confident it can solve the technical development problems, but is uncertain about the economics of the aircraft since it is unknown how long it will take or what it will cost to solve the technical problems.

Another problem foreseen by Atwood is the prospect that any price reduction on the Concorde would require a larger reduction on a U.S. supersonic price in order to keep the rate of investment on the two aircraft in the same relation. If the U.S. price were not reduced, he said, the market for a U.S. supersonic transport could be "seriously jeopardized."

Halaby Protests Liability

Washington—Federal Aviation Agency Administrator N. E. Halaby last week sharply protested a Justice Dept. decision to have the U.S. government pay 24% of any damages set in lawsuits resulting from the mid-air collision of a United Air Lines Douglas DC-8 and a TWA Lockheed 1049 Constellation over Staten Island, N.Y., on Dec. 16, 1960.

Halaby said he had been overruled by the Justice Dept. on his stand that an airways traffic control system cannot prevent accidents when aircraft do not follow the instructions of air traffic controllers. He said that it was his opinion that the Justice Dept. action and a TWA decision to pay 15% of the damages were taken to avoid the risks involved in litigation.

United will pay 61% of the damages under the three-way agreement. Lawsuits stemming from the accident are expected to total as much as $10 million.

Northeast Authority

U.S. Circuit Court of Appeals in Boston has granted Northeast Airlines authority to operate to Florida until Apr. 30 while the court reviews the Civil Aeronautics Board decision which would eliminate the airline's Florida routes.

Upon decision by the appeals court, both CAB and Northeast could request a rehearing which might lead to further extension of Northeast's Florida authority. Beyond this, both parties have recourse to the Supreme Court.

Northeast decided to use the appeals court in Boston, where the carrier's headquarters are located, in preference to the appeals court for the District of Columbia, site of the CAB, as a forum for the case.

Parties seeking appeal in a federal case may use either the court in their area or the court in their opponent's area.

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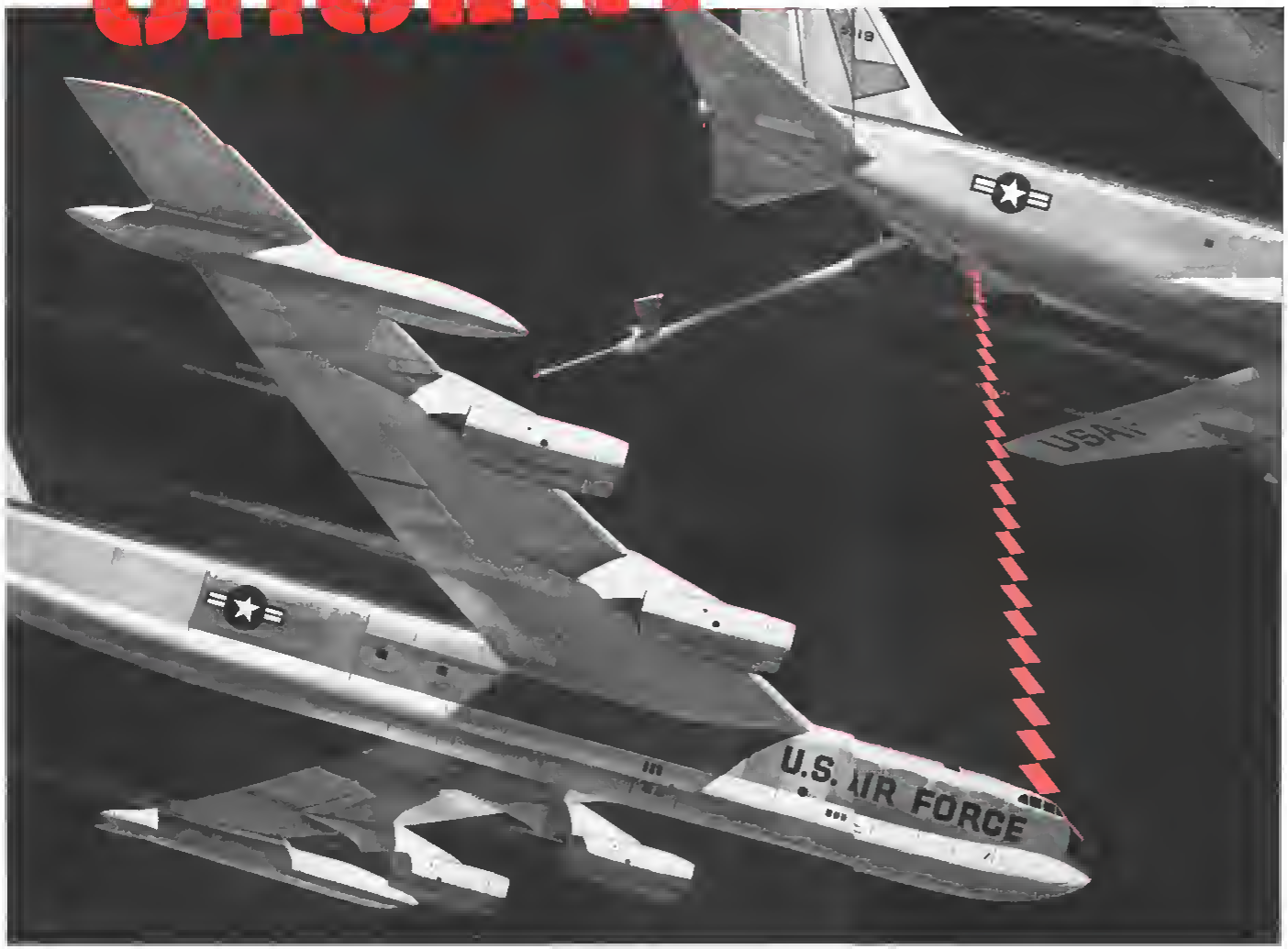

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BOAC Deficit Climbs to $215.6 Million

London—British Overseas Airways Corp. last year lost $34,160,000, making a total accumulated deficit of $215.6 million, and officials of the airline hinted here last week that fleet requirements projected to 1967 probably were excessive.

Sir Matthew Slattery, BOAC chairman, in referring to fleet size, said the decision rests on these points:

- **Whether international airlines** are successful in expanding the growth of both passenger and cargo traffic.
- **The extent to which** other airlines can be persuaded to refrain from adding excessive additional capacity, and the extent to which BOAC is able to retain its existing traffic rights.
- **Date of availability** of a supersonic transport for international operations and the extent to which it will replace existing subsonic jet transports, a situation Slattery called "unpredictable in any assessment of long-term requirements for subsonic aircraft."

Any reductions in the BOAC fleet will center on its 20 Boeing 707s. There are no plans to cancel any of the orders for 42 Vickers VC 10 aft-mounted jets. 12 are standard versions, and 32 are Super VC 10s. However, BOAC is negotiating with Vickers-Armstrongs to extend delivery dates and is studying the possibility of redesigning six Super VC 10s into all-cargo jets. These would be powered by the Rolls Royce Medway bypass engine planned for the Hawker Siddeley AW-681 V/STOL transport (AW Oct. 21, p. 23).

Slattery was relatively subdued in projecting BOAC's future and in criticism of its financial structure, which he once called "bloody crazy" (AW Oct. 15, 1962, p. 38). At that time, BOAC reported a $140-million loss, including an $88-million write-down of equipment capital costs.

The reason for his caution is the still-secret Corbett Report on BOAC's financial affairs. Completed by John Corbett, a private accountant, the report is in the hands of Minister of Aviation Julian Amery, who has indicated he will issue pertinent sections in a White Paper during an early session of the recommenced Parliament. The sessions were due to start Oct. 29 but have been postponed to Nov. 12 due to the appointment of Sir Alec Douglas-Home as prime minister.

Slattery said the association between BOAC and Cunard Steamship Co., in BOAC-Cunard services was proving advantageous, and results of the first five months of the current fiscal year are good. Slattery said BOAC hopes to break even this year, before meeting interest payments.

Another encouraging factor, he added, is that affairs of the BOAC-associated companies, which had proved a drain on corporation resources in the past, are now in good order.

In the first six months of the current fiscal year, BOAC earned $8 million more than in a comparable period a year ago and so far is showing an operating profit of $2.8 million.

With the reorganization of the BOAC associate companies now completed, results show an improvement of more than $5.6 million over last year. BOAC cut its losses in associated companies from $9.2 million to $3.4 million in 1962-63.

Operations of BOAC and BOAC-Cunard, Ltd. earned $258.7 million, about $840,000 less than the previous year.

Slattery said the decrease of $8 million in charters more than offset gains in passenger, freight and scheduled contract services. This, he explained, was due not only to changes in the market, but to planned withdrawal of BOAC's Bristol Britannia 102 turboprops and Douglas DC-7C aircraft from service.

In contrast, cargo shipments rose 18% over the previous year.

Slattery said BOAC had deliberately restricted its normal capacity growth during the year, in the hope that improvement in traffic would boost load factors. This attempt, he added, was not wholly successful, mainly because "BOAC's restraint was not matched by many other operators, who once again offered more extra seats than there were extra passengers to fill them."

As a result, the over-all load factor dropped from 45.8% in 1961-62 to slightly under 45% last year. At the same time, the break-even load factor fell from 52.4% to 46.5%.

Slattery said the steady decline in the average rate of revenue would continue.

BAC 111 Crashes on Test Flight

London—British Aircraft Corp.'s first BAC 111 twin-jet transport crashed last week on a routine test mission. Two pilots and five technicians were killed. It was the airplane's 54th flight since its maiden flight at Hurn, England (AW Sept. 2, p. 37).

The airplane was almost totally destroyed. The Royston Midas flight recorder was recovered intact along with bits of magnetic tape salvaged from the wreckage of the airplane's complex flight test instrumentation.

A project team was evaluating the Midas data but was not prepared to pinpoint the crash cause. The British Aircraft Corp. said the data proved valuable but would require further study.

The pilots were M. J. (Mike) Lithgon, deputy chief test pilot of Vickers-Armstrongs since 1960 and copilot on the BAC 111's first flight, and Richard Rumin, project pilot who formerly flew for BOAC and BEA. Lithgow held the world speed record in 1943, flying a Supermarine Swift F4.

Technicians aboard were R. A. F. Wright, senior flight test observer, B. J. Prior, assistant chief aerodynamicist and G. R. Poulter, flight test observer, all of Vickers and D. J. Clark, flight test observer, and C. J. Webby, assistant chief designer, both of Hunting Aircraft.

The airplane, owned by British Aircraft Corp. but painted in British United Airways colors, crashed in a hilltop field near Chicklade, Wiltshire, about one hour after it had taken off from the airport at Wisley for a test flight.

The BAC 111 had made 53 flights for a total of 82 hr. Second BAC 111 is due to make its first flight in mid-November.

Last week's flight was for aerodynamic testing, probably including stall characteristics with and without power. No transmissions were made to the Wisley tower prior to the crash. There were no other indications of any difficulties. Vickers officials last week said the entire program to date had been remarkably free of trouble.

One witness told Vickers he first saw the airplane at an altitude of about 500 ft., and it appeared to be yawing to port. Another heard a sharp crack while the airplane was at about 200 ft., just before striking the ground.

From the airplane's position after the crash and the resulting fire, there was speculation that it was near or at stall speed of about 104 kt. There was little evidence of any skid after impact. The airplane appeared to have pancaked onto the field after striking the ground with its right wing low.

The airplane was fitted with about 6,000 lb. of flight test equipment. Some magnetic tapes were salvaged.

The airplane, registered G-ASGH, was a Model 200 version (AW May 20, p. 41). It was insured for $2.8 million.

Evolution of the E-2A Hawkeye... Global Command Post

The Grumman E-2A Hawkeye pinpoints enemy air action long before it comes in sight. Within seconds, the destruction of the attacker is plotted and interception started, and not a word has been spoken.

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The entire plotting process is controlled by the E-2A Hawkeye through data links between itself, ground stations and friendly aircraft. Essentially, Hawkeye's early warning capability consists of high confidence auto detection radar, airborne computers, memory and data-link system. Yet it is a manned system, mating human judgment with the most advanced hardware of automation—a specialty at Grumman, as has been the case with many previous weapons systems.

In a battle situation, Hawkeye serves as a mother ship, directing its attacking forces against ground or aerial targets. Grumman designed the high flying, far ranging, all-weather Hawkeye for one purpose only: to provide tactical lead time, the most powerful deterrent to enemy action. It's a job Hawkeye does particularly well.

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AIRLINE OBSERVER

▶ New York-Florida market will become a proving ground this winter for the currently hot issue of excessive competition. Certain factions within the Civil Aeronautics Board would like to see a reduction of competition on several major routes, but the steady rise in traffic volume this year is minimizing the problem of over-capacity and, if the increase continues, could resolve the problem of excessive competition and reduce the need for any moves in this direction by the CAB. However, both Eastern and National will flood the Florida market with seats to demonstrate there is no requirement for a third carrier on the East Coast-Florida route. If successful, the Board could conclude that competition could be cut elsewhere despite the rising tide of traffic. Northeast, granted another winter season by the U.S. Court of Appeals will attempt to prove there is no need to cut competition, has already demonstrated that such actions will be followed by severe regional political pressures.

▶ Management study of Eastern Air Lines under way by Booz, Allen and Hamilton is scheduled to be completed at year end. Management changes at Eastern were frozen during the American-Eastern merger proposal period, and the study is a part of an overall reappraisal of organization and personnel requirements which were affected by attrition during the merger negotiations. Special emphasis in the study is on the sales area, but all phases of the airline's operation are under study.

▶ Israeli government is planning to build a new, centrally located international airport that would permit service to Jerusalem and Haifa for the first time as well as to Tel-Aviv. These three cities will be connected to the airport by a helicopter service planned by El Al for 1965 when the new center is slated to become operational. Equipment under consideration includes the 30 passenger Sikorsky S-65 plus the S-61 which would be used as an interim aircraft. Lack of service into pilgrim city of Jerusalem presents a serious drawback to El Al's promotional sales efforts. Flights to Jerusalem represent a major source of income to Arab country airlines which use the British built airport located in the Jordanian sector of the divided city.

▶ Transport fleet operated by Russia's Aeroflot on domestic and international routes during the peak traffic period last summer was dominated more than ever before by turboprop equipment. Flights listed on the Soviet carrier's "central timetable" included 286 Il-18 turboprop flights, 218 Tu-104 turbojet flights, 160 An-10 turboprop flights, 56 Tu-124 turbojet flights and 8 Tu-114 turboprop flights. Piston powered aircraft accounted for a total of 396 flights. By comparison, in 1960 the central timetable listed 116 Tu-104 flights, 72 Il-18 flights, 46 An-10 flights and a total of 596 piston-engine flights.

▶ Automatic "talking" weather broadcasting system is under development by Textron's Bell Aerosystems Co. for the Federal Aviation Agency. System involves a computer which examines all incoming teletype weather messages in a fixed format and stores information in a memory drum. Messages are automatically decoded on a presented schedule and then "talked-out" on a device called ORATE (Ordered Random Access Talking Equipment).

▶ A Canadian falconry expert has been training four falcons in Vancouver to keep gulls away from airports. Frank Beebe, working under a special project for the Canadian National Research Council, will locate the falcons at an unselected west coast airport to test how successfully gulls, a hazard to aircraft, can be frightened from flying in the vicinity of airports.

▶ Trans Texas Airways has been boosted from a local service airline to a major regional carrier in the southwest as a result of route awards granted to the airline in the Southwestern Area Local Service Case. Routes transferred from Braniff Airways and Continental Air Lines by the Board order give Trans-Texas a system of about 7,000 unduplicated route miles operating into 57 cities.

SHORTLINES

▶ **American Airlines** will place the first of its Boeing 707-323C all-cargo fanjet transports into service next month. First of the four aircraft ordered by American was rolled out by Boeing last week.

▶ **American Society of Travel Agents** has asked the Civil Aeronautics Board to reconsider its decision not to review ASTA's complaints against charter operations.

▶ **Civil Aeronautics Board** has ordered the suspension and investigation of a petition by Western Air Lines to increase coach rates on certain routes. Corresponding petitions by Trans World Airlines and United Air Lines filed following the Western request were also suspended. Western based the petition on a need to increase some fares to reflect tariff construction.

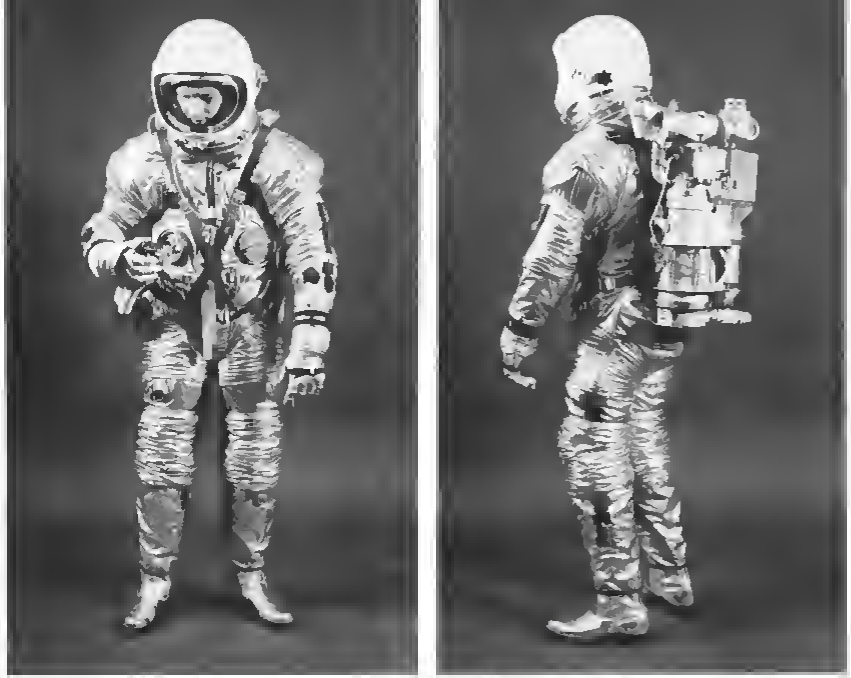
▶ **National Airlines** has reported net earnings of $811,000 for the first quarter of its current fiscal year. In the same period last year, a net loss of $479,000 was recorded.

▶ **Los Angeles Dept. of Airports** reported a net income of $2.1 million for the fiscal year which ended June 30, after providing $3.9 million for interest and depreciation on airport bonds and paying $4.2 million in operating costs and other expenses.

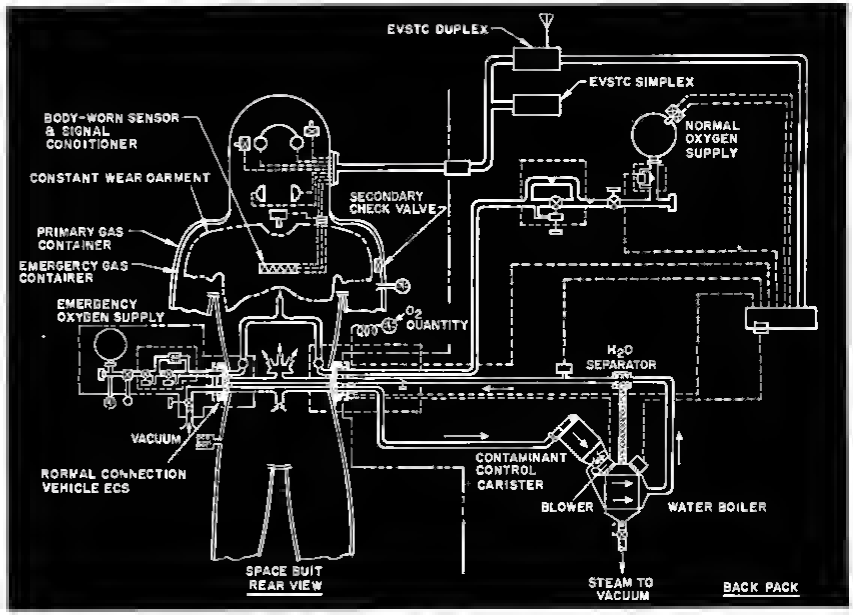
▶ **North Central Airlines** set a new all-time company record in passenger traffic for the first nine months of 1963. Number of passengers carried during the first three quarters increased 8% over the same period last year and revenue passenger miles rose 6% in the corresponding period.

▶ **Soviet Russia** has opened another major airport on the Caucasus coast of the Black Sea to handle heavy traffic into the resort area. New field is at Gudauta between Sochi and Sukhumi. The Moscow-Sochi run is the most heavily-traveled in the Aeroflot system. Service includes 20 Muscow-Sochi round trips daily by Il-18 and An-10 turboprop aircraft, plus flights from many other Russian cities.

▶ **Seaboard World Airlines** reported a net profit of $657,280 for the first eight months of the year compared with $334,949 reported in the same period last year. Profit does not include a special provision of $2 million—a reserve to cover possible future loss on the sale of piston engine aircraft.

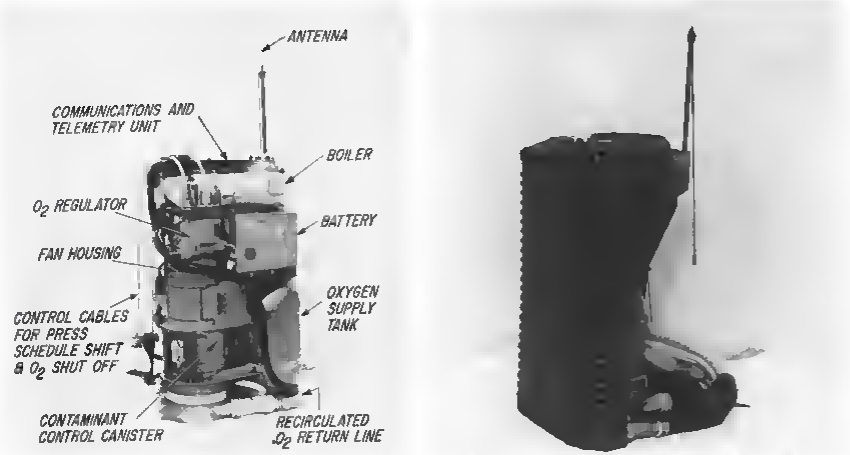


FRONT VIEW OF APOLLO suit prototype (above, left) shows technician hooking backpack umbilical cord to suit connector. Left port has a blank plug. Left arm dial is pressure gage. Rear view (right) shows backpack without cover. Knob on helmet adjusts inner liner.



CIRCULATION FLOW FROM the backpack life support system through the Apollo suit is shown schematically (above). The backpack will permit two of the Apollo astronauts to explore the moon's surface for periods of up to 4-hr. It weighs 31 lb.

Hamilton Standard Starting Manned Tests of Advanced Apollo Suit Design Prototypes



PROTOTYPE BACKPACK is shown without its cover (lower left) and with its cover in place (right). Note three-line umbilical cord.

By Donald E. Fink

Windsor Locks, Conn.—Manned tests with advanced prototypes of the Apollo spacesuit and backpack have started at United Aircraft Corp.'s Hamilton Standard Div. here, as the suit development program enters its final stages on schedule.

Hamilton Standard, prime contractor in the program, is developing the backpack—a portable life support system for Apollo astronauts who will explore the moon's surface.

International Latex Corp., Dover, Del., major subcontractor in the program, is developing the suit.

Development is on a three phase schedule. Phase one began in October, 1962, with a $1.55 million contract from the National Aeronautics and Space Administration. It involved preliminary design and integration of major subsystems (AW Oct. 22, 1962, p. 33).

Phase two, now under way, will yield prototypes of three suit models. Two prototypes of the first suit model were completed in August, meeting the original 10-month delivery schedule. Production of second suit prototypes began this month.

One of the first suit prototypes was sent to NASA for mobility tests. The other was used by Hamilton Standard for compatibility tests with the prototype backpacks.

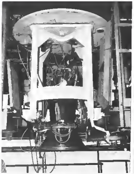
The second suit models have improvements resulting from those tests, and other refinements. They will be used by NASA in a full-scale test and evaluation program.

Preliminary work also has begun on prototypes of the third suit model, but they will not be built until the second model suits have been thoroughly evaluated. Design will not be frozen even with production of the third model. Latex engineers said refinements will continue throughout the Apollo program, as was the case with the Mercury suit.

The third phase of the Apollo suit program, running concurrently with the second, includes environmental testing of suit materials and the physiological tests that Hamilton Standard is conducting with subjects in the prototype suits.

The suit is designed for a 3.5 psi operational pressure and a 5 psi emergency pressure. It has a 100% oxygen atmosphere to match that of the Apollo spacecraft, and weighs 21 lb. Its envelope has seven layers. They are, from the inside out:

- **Constant wear garment**—A loose-weave nylon suit resembling a two-piece set of long underwear with integral socks.
- **Suit liner**—A thin coverall with knitted wrist and ankle cuffs, fabricated from a small weave, smooth finish nylon.
- **Ventilation distribution system**—A network of nylon fabric tubes, filled with a stiff nylon mesh which prevents the tubes from being pinched shut without restricting the oxygen circulation.
- **Secondary pressurization layer**—A heavy, tight weave nylon layer which is tailored to the general contour of a man's body, but has no joints. This layer inflates automatically if the primary layer is punctured.
- **Primary pressurization layer**—A sec-



Apollo Service Module Engine Fired

First photographs of Apollo service module engine firing were taken during a recent test on the C-3 stand at the liquid rocket plant of Aerojet-General Corp. near Sacramento, Calif. Hold-down test firing did not include a long, thin skirt which will be used in space operations to make the most efficient use of engine gas stream. The skirt will be 8 ft. long, of titanium and colombium. The system which has encountered development problems (AW July 22, p. 107), will play an important part in such Apollo mission maneuvers as mid-course corrections and rendezvous with the lunar landing module.

ond layer made of the heavy tight-weave nylon, but with convoluted neoprene rubber joints at the neck, shoulders, elbows, thighs and knees.

• **Restraint layer**—An outer containing layer, similar to the casing of a tire and tube combination. It is made of a lighter weight nylon and has an aluminized outer coating. The restraint layer is attached to the primary pressurization layer at the joints and at the pressure glove and boot connectors.

• **Thermal insulation layer**—A loose-fitting, two-piece garment of multiple-layered aluminum coated mylar, designed to provide thermal insulation on the lunar surface. Included with this garment are heavy mittens which slip over the pressure gloves. The thermal layer will be contoured to cover the life support backpacks, which the Apollo crewmen will strap on prior to leaving their Lunar Excursion Module (LEM) on the moon's surface.

All layers of the pressure suit connect with integral leather boots, which have an aluminized outer coating and rubber soles. The legs of the outer thermal garment have integral pressure boot covers, to protect the astronaut's feet from lunar cold.

A special lunar overshoe is being developed to further protect the feet and also to provide a walking platform to cope with different terrain conditions.

The overshoe consists of two glass fiber shells. The upper portion is hooked over the toe of the insulation-covered pressure boot and is strapped across the ankle like a roller skate.

The upper shell is separated from a glass fiber foot pad by a half-inch thick ring of silicone foam, shaped to match the outer edge of the foot.

The foot pad, which can be varied in length and width, will function like a snowshoe if the lunar surface is found to be soft and porous. The space between the two glass fiber layers will be vented to the lunar environment and will form a half-inch vacuum barrier for further thermal insulation. The overshoe foot pad also will be rubber soled.

Apollo crewmen will wear the suits, unpressurized and minus the backpacks, during the initial lift-off on the lunar mission. The suits will be connected to the command module's environmental control system for crew oxygen and ventilation. They will automatically pressurize at 3.5 psi. if the spacecraft's 5 psi. pressurization system fails.

A 10 psi. cabin pressure was considered in the original Apollo spacecraft design, when it was to have a two-gas atmosphere. This later was reduced to 7.5 psi. When a 100% oxygen atmosphere was selected, NASA further reduced the cabin pressure to 5 psi.

The 3.5 psi. operational suit pressure was selected to give the lunar exploring astronauts as much mobility as possible. After they land the LEM on the moon, they will make a gradual transition from the 5 psi. cabin pressure to 3.5 psi.

The 5 psi. emergency suit pressure will be used by the crewmen if an emergency cabin decompression to the operational suit pressure occurs and is rapid enough to create nitrogen embolisms in their blood.

One crew member may be required to wear the entire suit throughout the flight. The two who are to land the LEM on the moon will wear their suits from the start of the mission until the LEM has been reoriented on the front of the command module during translunar flight and given a systems checkout (AW July 22, p. 141). They will return to command module and remove their suits for the rest of the flight.

But they will keep the suits within

easy reach in case of a command module pressure leak. The suits also will function as the backup pressurization systems in the LEM.

The LEM astronauts will don their suits prior to entering the vehicle for the flight down to the lunar surface. Once inside, they will connect the suits to the LEM's environmental control system. The backpacks will be used outside the LEM and possibly during transfer between vehicles.

Because the suit will be removed during portions of the lunar flight, it had to be designed so that the wearer could rapidly don it by himself. Apollo astronauts will be able to don their suits in about 5 min., according to L. F. Shepard, director of research and engineering and Apollo program manager at Latex. This will be fast enough to protect the astronauts from most emergency situations other than catastrophic decompression of the spacecraft, he said.

The suit is put on like a pair of coveralls and is closed with zippers extending from the crotch to the neck. Aluminum-nickel alloys are used in the zippers, which are equipped with leather pull straps.

Heavy Socks Worn

The crewmen who remove their pressure suits during the flight will be clothed only in the constant-wear garment. It contains the network of biomedical telemetry sensors which are used to monitor the astronaut's body functions. It also has compartments for deodorant pads and pouches for and collection of urine and feces. Heavy knit socks are worn over the integral socks of the inner layer to fill out the suit's pressure boot.

The inner liner, which resembles a light-weight coverall flying suit, gives the pressure suit a smooth, low friction interior which makes it easier to put on. It also helps prevent chafing.

The secondary pressurization layer hangs slack during normal suit operations and provides further protection against chafing. If the primary pressurization layer is punctured, a sensor between the layers automatically inflates the inner one.

The secondary layer has no integral joints, but when inflated it presses against the joints of the primary layer and functions with them. Mobility loss with the secondary layer pressurized is relatively low, Shepard said.

Another major factor affecting mobility is the design of the joints in the primary pressure layer. The Apollo suit joints, which resemble extended rubber bellows, are dipped in layers on aluminum matrices with reinforcing nylon added between the layers. Glass fiber cones are attached to the lower ends of the joints at the shoulders and thighs to transition smoothly from the joint openings to the smaller diameters of the arm and leg sections of the suit.

The ultimate goal of the suit designers is to develop a suit that will give the wearer as much mobility as possible, because of the requirements of the lunar exploration mission. Leaving the LEM to explore the moon, for example, will involve bending and crawling in the hatch tunnels, climbing ladders and walking.

The pressure gloves and the helmet are attached to the suit with O-rings and bearing seals. Spring lock devices in the attachment rings permit the wearer to put the units on using only one hand—a feature dictated by the self-donning requirement. The lock rings on the suit have three settings—open, engage and lock. When the ring is set at open, three spring loaded lock pins around the circumference of the ring are withdrawn and the gloves or helmet can be removed.

To put them back on, the wearer sets the ring locks in the engage position, which extends the lock pins under spring tension. As the glove or helmet adapter rings engage their respective lock rings, the wearer locks them in place by pinching the rings together on one side. This triggers at least one of the lock pins which gives way and then snaps shut, locking the unit in place.

The ring can be locked at the other two points in the same manner, while the first pin holds the glove or helmet onto the suit. The suit lock rings then are rotated to the lock position to prevent the pins from being accidentally tripped. The locking device has now been adapted by NASA to the Gemini spacesuit, Shepard said.

Pressure Helmet

The pressure helmet developed by Latex for the Apollo suit has two glass fiber shells—a close-fitting liner with five adjustable suspension pads around the interior, and an outer pressure shell. The liner, which is attached to the outer shell, also has padding around the faceplate to ensure a snug but comfortable fit on the astronaut's head.

Head twisting motion is transmitted to the helmet's outer pressure shell, and the entire assembly rotates on the neck O-ring. Limited tilting and up and down movement of the head is permitted by the neck rubber joint.

The space between the larger diameter outer shell and the liner is used for internal storage of the visor. This reduces the visor sealing problem, because the suit's internal pressure forces the visor out against its seat in the pressure shell.

The visor cannot be opened when the suit is pressurized.

A separate sun visor has been designed for the helmet to protect the astronaut's eyes from the brilliant sun-

light to which they will be exposed on the moon's surface. It clips onto external attachment points on each side of the helmet and is easily removed. It also can be pivoted up on top of the helmet for temporary storage without removing the clip assembly.

Included in the helmet package are the earphones and microphone of the communications system and telemetry components for biomedical monitoring. A pressure-tight feeding port is located directly in front of the mouth.

The helmet oxygen inlet system consists of small slit ports around the front perimeter of the faceplate. The oxygen flow serves four purposes—to clear mist from the faceplate, to purge carbon dioxide exhaled into the helmet from the lungs, for breathing and to cool the face and head.

The pressure suit's outer restraint layer, which ties all layers together in a neat package, resists abrasion and protects the rubber joints and other connectors. The restraint layer has a series of straps along the arms and legs and across the shoulders and torso. These take some of the load off the pressure suit zippers and also can be used to adjust the suit's fit.

Eight Suit Sizes

At this stage in the suit's development, Shepard said they plan to make suits in eight sizes, following the Air Force's standard height and weight charts.

It has not been determined, he said, if movements of astronauts with odd sizes might be restricted. NASA will investigate that possibility during mobility tests. If the penalty is severe enough, the suits may have to be tailor made.

The suit's restraint layer also has attachment rings for the backpack straps, pockets for backpack monitoring gages, and two umbilical cord attachment ports. The ports are located on each side of the suit's chest section, just above the waist.

The ports are of a quick connect-disconnect design that employs a one-quarter turn screw lock. This design is under study, however, and may be replaced with a plunger type connector with spring locks.

The left attachment port will be used to connect the suits to the environmental controls in both the command module and the LEM during flight. The right port will be used by the lunar exploring astronauts for simultaneous connection of the portable backpack before leaving the craft for the moon's surface. This will permit them to change to the portable system gradually and with no pressurization loss.

Once the astronauts are operating from the backpack, the LEM system will be disconnected and the left port will be used to attach a portable emergency oxygen unit to the suit.

The backpack is a 31-lb package (AW Apr 22, p 95) which will permit astronauts to leave the LEM vehicle on 4-hr. expeditions. The package measures approximately 25 in. high, 15 in. wide and 8 in. deep. Prototypes of the system currently are being tested with a "canned man" in Hamilton Standard's space simulation facility. The canned man is a machine that generates the heat and moisture loads expected from a human and evaluates the backpack's ability in a vacuum.

Major Components

The backpack has nine major components:

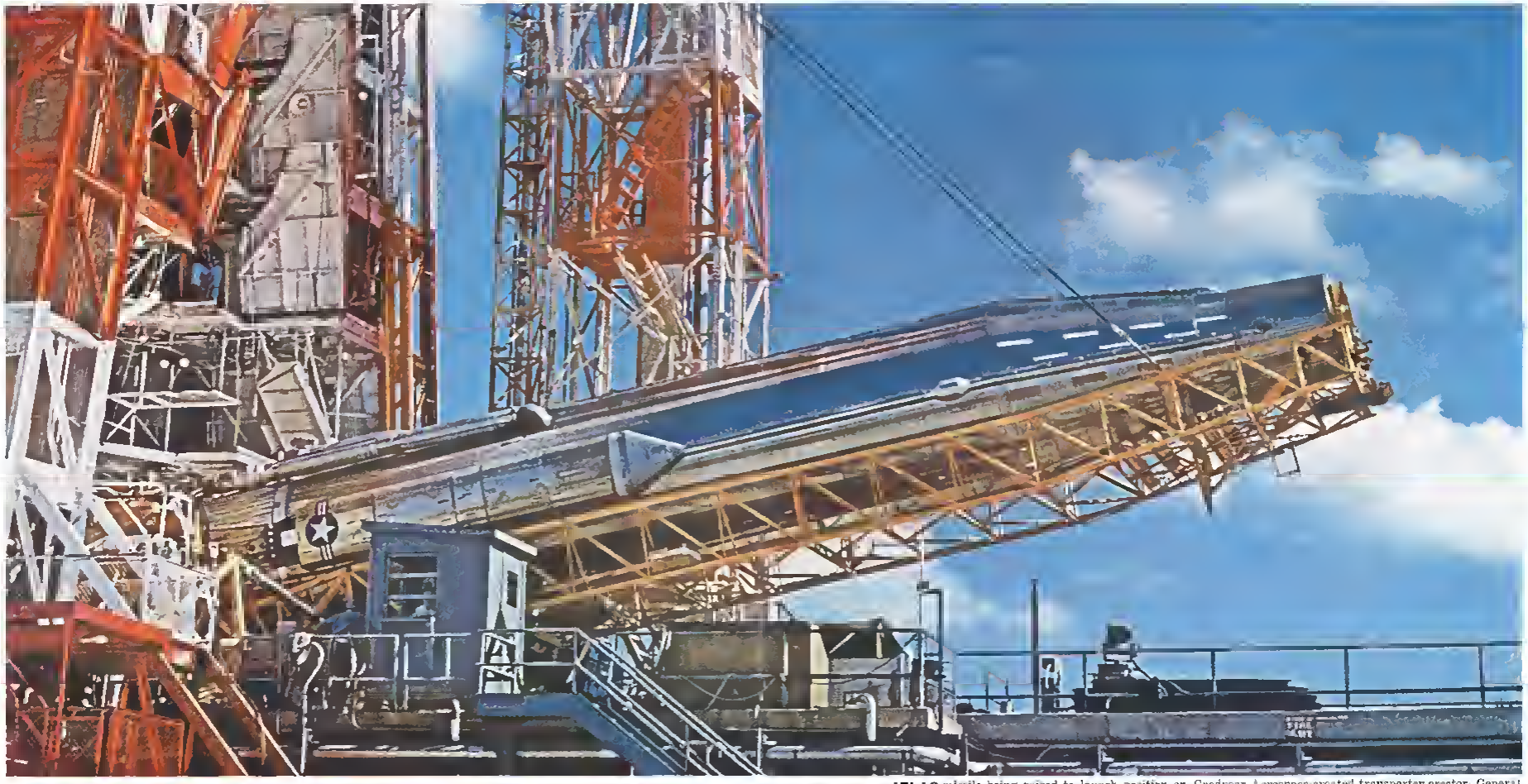
- **High pressure oxygen tank,** with a 4-hr. oxygen supply at 800 psi.
- **Contaminant control canister,** which contains a centrifugal particle filter, a lithium hydroxide element for carbon dioxide removal and an activated carbon odor filter.
- **Battery-operated fan** that re-circulates oxygen through the suit and provides the cooling ventilation flow.
- **Battery-operated, eight-channel** communications unit for voice communications and transmission of biomedical data.
- **Silver-zinc, rechargable battery** which will deliver 28 v. of power for a minimum of 4 hr.
- **Water boiler,** to dissipate heat and moisture from the suit by boiling water off into the lunar vacuum.
- **Water separator,** which removes excess moisture from the suit's oxygen circulation flow and funnels the water to the boiler.
- **Gas flow regulators** and connecting tubing, including the umbilical cord which has three flexible flow lines.
- **Glass fiber shell,** which will protect components from impact damage and lessen the chance of snagging them on the suit's thermal cover or on hatches in the spacecraft.

No Special Shielding

Major backpack components are tied together with bands and braces, forming the basic structure and eliminating the need for a separate framework. Materials used in the tanks and tubing are conventional aluminum, stainless steel and alloy steel. Some glass fiber and plastic materials also are used in the braces.

All the materials are compatible with the space environment, according to Roger Weatherbee, Hamilton Standard's Apollo spacesuit program manager. He said no special micrometeoroid or radiation shielding will be necessary in the suit or backpack.

The primary oxygen flow from the backpack into the suit begins in the main storage tank and leads through a flow regulation valve to the umbilical



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GOODYEAR AEROSPACE

cord oxygen line. Inside the suit, the oxygen is piped to the helmet faceplate's circulation system.

The exhaust flow from the helmet circulates down through the suit, where it is picked up by a multiple gas collector near the waist and piped to the backpack through the return flow line of the umbilical cord.

The return gas flow, which is warm, moist and contaminated with carbon dioxide, is passed first through the centrifugal debris separator, where moisture droplets and solid contaminants are spun out of it. It then enters the lithium hydroxide and activated carbon filters where carbon dioxide and trace and odor contaminants are removed. By products resulting from the filter reaction are lithium carbonate, heat and water.

Cooling Reduces Moisture

The gas flow then enters the circulation fan. A pressure drop created by the suit's circulation system is overcome and the gas flows on to the boiler. The gas is hotter than when it entered the backpack because of heat generated by the pump motor and the reaction in the lithium hydroxide filter, so it is cooled to 40-45F by heat exchange in the boiler.

The cooling condenses some of the moisture out of the flow, but the gas still is saturated when it leaves the heat exchanger. The moisture content is further reduced by ducting the gas through a water separator which forces the flow around a sharp turn. This causes excess moisture to condense on the wall of the separator duct, where it is picked up by a wick and drained into the boiler reservoir.

Gas Flow Maintained

The reconditioned gas flow enters the suit through the third line in the umbilical cord which feeds the network of nylon circulation tubes reaching to the extremities of the suit. The arm tubes, which pass through the suit's liner into the pressure gloves, are held in place by end loops that slip over the wearer's middle fingers. The leg tubes are attached to the leg liners and exhaust into the pressure boots. The return flow from the suit's extremities also is picked up by the multiple gas collector and recirculated.

As the backpack fan maintains the circulating gas flow, the oxygen regulation valve continues to feed oxygen into the system through the faceplate vents. The gas flow circulating through the suit is the only means of cooling the wearer. A constant temperature is maintained by boiling water and venting the steam to the moon's vacuum.

As the heat load generated by the wearer increases with activity, the boiler temperature rises and a greater volume of steam is exhausted to maintain the constant temperature. The wearer can make small adjustments in the cooling rate of the circulation system by throttling the return gas flow from the circulation fan.

Primary Support System

Since the suit and backpack will be the primary life support system on the moon, Weatherbee said greater care had to be taken during the design and development phase to ensure that material and seal specifications were met. The suit also had to be designed with a certain amount of redundancy, such as the secondary pressurization layer.

The emergency oxygen supply was included in the backpack system for the same reason. The emergency supply package consists of a small, 7,500 psi container and a flow regulation valve. It will engage automatically if the primary supply is cut off or if it is expended.

On current suit models, the emergency supply is carried by a shoulder strap and is attached to the suit's left umbilical port. The final suit model probably will have it mounted on the backpack.

Increase Flow Rate

In the backpack itself, redundancy was not considered necessary for the circulation system. If the fan motor or the battery failed, for example, the suit occupant would be uncomfortable but in no immediate danger. The oxygen flow rate could be increased enough to purge carbon dioxide from the system and to maintain a limited circulation flow. Most of the cooling effect of the circulating gas would be lost, but an astronaut on the moon could function well enough under the circumstances to return to the LEM, Weatherbee said.

Apollo mission requirements call for three backpacks to be carried in the excursion module. One backpack will serve as a backup system. The expendables in the backpacks, such as the lithium hydroxide element in the filter canister, the oxygen tank and the battery, are designed for easy removal to permit replacement or recharging. The backup unit would be used only if a major component failed in one of the other backpacks.

A combined telemetry and communications unit is being supplied for the backpack by International Telephone and Telegraph Corp.'s Kellogg Div. It consists of a duplex component with a simplex backup. The unit, called an extra vehicular suit telemetry-communications set, is a long, thin, rectangular package on top of the backpack's boiler water tank. It has eight channels for voice communications with the LEM.

and the orbiting command module, and for telemetry of biomedical monitoring data.

Other major subcontractors and suppliers in the spacesuit program include backpack batteries—Eagle-Picher Co.; gas flow regulators—Carleton Controls Corp.; tanks—Tapco Div. of Thompson Ramo Wooldridge, Inc.; precision sensors and controls—Cummin Controls Corp.; Parker-Hannifin Corp.; Bourns Inc.'s Instrument Div.; and Gulton Industries, Inc.

Republic Aviation Corp. conducted environmental tests on early suit designs, suit materials and backpack prototypes. Future testing will be conducted in an expanded space simulation facility now under construction at Hamilton Standard.

Zero-G Tether Tests Seek Pilot Restraint

Dayton, Ohio—First conclusions of experiments with design of tethers for astronauts working outside spacecraft supports use of three-point harness attachment to eliminate undesirable tumbling at the end of a life line.

Project flights by Aerospace Medical Research Laboratory of Wright-Patterson AFB have used a KC-135 to attain zero-g effects similar to those a spaceman might anticipate.

Joseph W. Heltzel, a civilian project engineer attached to the crew stations branch, reported that five flights to date have permitted 72 maneuvers in a zero-g condition. Heltzel said 65 of the maneuvers produced usable information on 21 harness configurations.

Another 20 will be tested on the remaining four flights, Heltzel said. The 41 configurations were selected from 160 first considered.

Primary goal of the flights has been to find a simple harness able to absorb g's of sudden deceleration and impact without injury to the astronaut, disorientation or spin.

Results could be used in forthcoming Gemini flights, the laboratory feels, when in one experiment an astronaut is to practice exiting from the two man spacecraft.

Heltzel was the subject on each experimental flight. As a tether he used 25 ft. of parachute shroud line attached to various harnesses under consideration.

During each maneuver Heltzel pushed himself horizontally out from a board when the aircraft reached zero-g. As he fell free, Heltzel stabilized his body rigidly to anticipate the impact when he reached the end of the shroud line.

Tumbling resulted in almost every case. Only four harness configurations did not cause an undesirable spin.

With a harness using a chest attachment Heltzel's head was pulled down and the tumble was toward the aircraft's floor as if in a forward somersault. A back harness attachment pulled him up as if starting a back dive.

Such reactions showed the advisability of using a three-point attachment, Heltzel felt. Most suitable one considered would attach on each thigh and on either the chest or the back, to prevent tumbling by absorbing the impact at the end of the line over a wider area of the body.

Impact forces measured by accelerometers attached to Heltzel are being evaluated. The accelerometers were mounted in two packages, each containing devices to measure forces on three axes. They were placed on Heltzel's chest and in a pilot's helmet modified for the experiments.

A major problem among those encountered was line entanglement as Heltzel floated away from his push-off point. Another undesirable phenomenon was the rubberized effect of the nylon, which will be replaced in future tests by steel cable.

Additional experiments will utilize a reel to study problems encountered as a subject is drawn back.

A harness also could be incorporated within a pressurized suit, project workers feel. That would eliminate the need to don a harness separately.

Apollo Tether Study

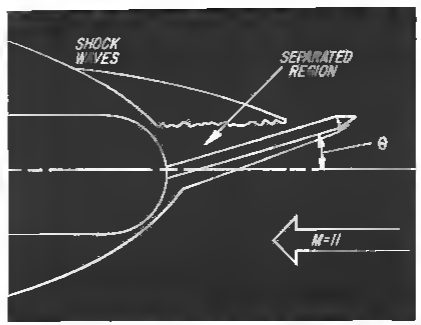
Dayton, Ohio—Best way to tether a man to a work station in the Apollo command module is under study in tests started recently by Massachusetts Institute of Technology and Aerospace Medical Research Laboratory of Wright Patterson AFB.

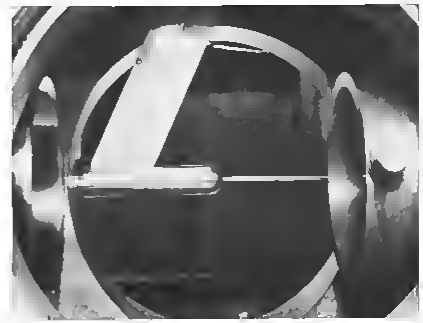
Two flights in a KC-135 provided 30 experimental runs at zero-g. A subject performing tasks at a crude mock up of the guidance and navigation panel was observed by a representative of North American Aviation, Inc., prime contractor for the Apollo.

The study evaluated tethering under normal operations and without cabin pressure.

One of the subject's tasks was to align a combination of stars and landmarks using two controls at zero-g. The subject's right hand was on the attitude control. His left hand controlled the line of sight tracking equipment.

Basic approaches to tethering used boots with toe hooks and Velcro sandals developed by North American in combination with restraints which attached the subject's hips to the work panel by side springs, rear springs or a rigid bar.





SPIKE DEFLECTION CONCEPT for control of spacecraft at hypersonic speeds was most effective at a 6-deg inclination (left). Test model (right) was a stainless steel, ½-in. dia. cylinder, shown in the Aerospace Research Laboratory's 3 in. wind tunnel.

Spike Use Studied for Hypersonic Control

By Roderick D. Hibben

Dayton, Ohio—Control of flight vehicles at hypersonic speeds by deflecting a nose-mounted spike is under investigation at the Wright-Patterson AFB Aerospace Research Laboratories here.

A stainless steel spike was tested first, to be followed later by evaluation of aerodynamic gas and liquid spikes as possible solutions to re-entry burn-up problems.

Aerospace Research Laboratory engineers also think that lengthening of a disintegrating steel spike from within the flight vehicle as the tip ablated might solve the burn-up problem.

First measurements of lift and drag coefficients using the stainless steel spike were made at a fixed Mach and Reynolds number in tests in the laboratory's 3-in. hypersonic wind tunnel recently.

The flight vehicle shape selected was a ½-in. dia. cylinder, hemispherical at one end (see photo above). Heat transfer to the model, along with drag, was reduced by choosing a spike length to vehicle body diameter of one to four. The spike was ¼-in. dia.

Lift and drag coefficients were calculated at Mach 11.76 from 180 pressure readings recorded at ten holes located on the model surface. The spike was mechanically rotated through 360 deg. in 20 deg. intervals.

An electrical breakdown of the gases between the model and wind tunnel wall—a glow discharge—was initiated to observe shock wave patterns around the spike. Patterns were recorded using a Schlieren photographic technique in which the diffraction pattern seen in the photograph shows sharp density changes in the high speed gas flow.

Stagnation conditions, under which the moving fluid in the wind tunnel is at zero velocity relative to some point on the stationary model, occurred at 1,300F under 400 psia during the test. The Reynolds number—a measure of fluid flow in the wind tunnel—was 28,700 in. at Mach 11.76.

The greatest spike deflection studied, so far, has been 7.5 deg.

Maximum lift was generated at about 6 deg. spike deflection.

The largest lift to drag ratio was 0.74 at about 3.3 deg. of spike deflection. It decreased at greater deflections.

Aerospace Research Laboratory's 3-in. hypersonic wind tunnel was capable of simulating 100,200,000 ft. of altitude. However, the deflectible spike concept is seen as a possible hypersonic control device for altitudes as high as 400,000 ft.—well below extent of the U. S. standard atmosphere of 435 mi.

Although the spike deflection concept as a control system is thought to be new, the use of a spike rigidly attached to the nose cone of a rocket or missile as a means of separating airflow, reducing drag and lowering heat transfer to the cone has been known for several years.

Measurements made at the Aerospace Research Laboratory, Langley Research Center and Princeton University showed that addition of a straight spike to the vehicle nose cone reduced drag by about 10 to 16%.

One of the many problems in designing controllable hypersonic vehicles has been to prevent the nose cone from burning up from the high heating rates it experiences at speeds above Mach 5. The need to maintain sustained hypersonic velocities in future flight vehicles also has caused serious material problems.

Later evaluations will seek to determine if aerodynamic spikes could be created by short bursts of gas or liquid material from the vehicle nose cone. A liquid spike might cool the nose of the vehicle as well as provide flight control for the vehicle.

At the present time, liquid spikes appear to be more promising than gaseous spikes since diffusion of the gas in the latter may not allow the spike to form long enough to generate lift.

In the near future, Aerospace Research Laboratory engineers plan to check a recently published Russian theory which predicts the lift to drag ratio of a fixed spike attached to any body shape.

New Pressure Gage

Precision pressure gage, called the hypsometer, has been developed by USAF's Office of Aerospace Research to improve the accuracy of measuring altitude. Hypsometer developed by a team under direction of Dr. W. C. Wagner, measures boiling temperature of butylbenzene electrically heated and kept at boiling for the duration of test balloon flights which have lasted up to three weeks.

The hypsometer, according to USAF, has an altitude error at 120,000 ft. (4.71 mb. pressure) of about ½ that of other altitude measuring devices—240 ft. compared with 2,600 ft.

PRODUCTION BRIEFING

McDonnell Aircraft Corp., St Louis, Mo., has received a $310.2 million fixed-price incentive contract as additional funds for F-4B, F-4C and RF-4C Phantom 2 aircraft. The Navy contract converts two existing letter contracts. Previous obligations under the two letter contracts amount to $315.2 million.

Gyrodyne Co. of America, Inc., Long Island, N.Y., has a $7.4-million supplemental agreement to an existing cost plus incentive fee contract for long lead time items to support Fiscal 1964 procurement of QH-50C drone anti-submarine helicopters (DASH). Previous obligations under this contract total $11.7 million.

Bendix Pacific Div. of Bendix Corp., North Hollywood, Calif., will design, develop and manufacture the hydraulic equipment for thrust vectoring the four solid acceleration rocket motors to be mounted in the tail of the Air Force X-20 (Dyna Soar) space glider. Contract is from Boeing for $650,000.

Honeycomb Products, Inc., Miami, Fla., will supply phenolic impregnated glass fiber honeycomb core material for the bulkheads in the second stage of National Aeronautics and Space Administration's Saturn 5 rocket, under a $707,000 contract from North American's Space & Information Systems Div.

Bendix Corp., Towson, Md., has been awarded a $1-million Navy contract to design and manufacture the tracking and computing system and perform systems integration for a mobile all weather missile range safety system. It will monitor the early phase of missile flights from Pt. Arguello and Vandenberg AFB.

Garrett Corp., Los Angeles, has received a $19.6-million follow-on contract for production of environmental, central air data, and emergency ram air turbine systems for the McDonnell F-4B, F-4C and RF-4C aircraft.

Beckman Instruments' Systems Div., Downey, Calif., will build two data acquisition and one recorder unit to evaluate the Apollo spacecraft under flight conditions of thrust, temperature and vibration under a $1-million contract from North American Aviation's Space & Information Systems Div.

Marquardt Corp.'s Pomona Div. will develop eight Atlas missile crew procedure trainer systems under a $1.9-million Air Force contract. Systems will be used at various Strategic Air Command bases to train Atlas crews.

French Helicopter Carrier Shown in First Tests

La Resolue, the French navy's new helicopter carrier, is seen (top) at Brest during first landing tests with a Sud Super Frelon turbine-powered ASW helicopter (AW June 10, p. 96). Note helicopter hovering just off flight deck, aft of superstructure. The carrier is expected to go into operational service when it completes its sea trials next year. In the 12,000-ton class, La Resolue has a top speed of 26 kt., and can handle 12 heavy helicopters of the Super Frelon size. Super Frelon is shown in hovering flight (center) and on deck (bottom) near aft elevator. Flight deck measures 330 ft., and ship is 640 ft. long, with 81 ft. beam.

Even if you invented a hearing aid as good as this one,

this would make it better.

You're looking at a Fairchild Silicon Planar transistor. The same basic transistor that goes into a 110 ton Titan I missile—and a Sonotone hearing aid weighing less than 1/5th of an ounce. Planar transistors resist shock, heat and moisture far better than ordinary transistors. They make for a whole new kind of reliability—and *durability*. Which may be good to hear. Particularly if you're a little hard of hearing.

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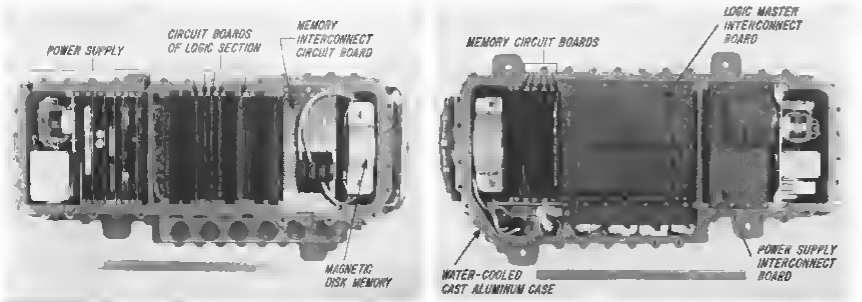


PRODUCTION PROTOTYPE of missile borne guidance/checkout computer slated for use in Minuteman ICBM squadrons starting in Wing 6, is shown in closeups indicating construction details. Photo at left is upper view of computer with top cover removed; right photo shows bottom with bottom cover removed. Note that interconnect boards for memory and logic sections are at opposite sides of computer, leaving circuit boards accessible for removal or checkout through connector contacts at alternate edges of boards.

Microcircuits Boost Minuteman Capability

By Barry Miller

Anaheim, Calif—Extensive use of microcircuitry throughout the computer, flight controls, inertial platform and associated electronics comprising the guidance and control system of the Improved Minuteman ICBM is expected to make possible greater missile reliability, range and accuracy.

In addition, microcircuitry will vastly simplify support and control of the silo-emplaced weapon, slated for Wing 6 and later Minuteman installations.

The first production prototype guidance and control system incorporating microcircuitry is nearing completion here at Autonetics Div. of North American Aviation, associate prime contractor for Minuteman guidance and control. A lightweight digital computer, which is the heart of the system, was assembled recently and currently is undergoing extensive testing.

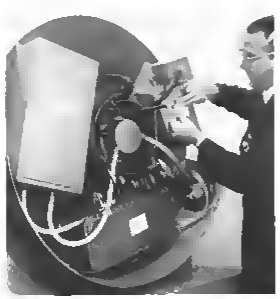
Autonetics is working under Air Force Ballistic Systems Div. contract to design, develop and test production prototypes of Improved Minuteman's guidance and control system and ancillary launch equipment.

The implied and frequently stated potential benefits of microcircuitry—increased reliability, reduced size and weight, lower power and lower costs—are apt to overshadow what may be an equally important effect of its use in Improved Minuteman.

Combined with other design and packaging techniques, microcircuitry enables computer capacity to be doubled, thereby permitting the missile-borne computer to perform a more complex group of functions than earlier machines in Wing 1 through 5 missiles and to assume functions not previously performed.

By designing the computer to perform many more roles than its critically important flight missions—an approach Autonetics initiated in its Hound Dog air-to-surface missile, continued with the first generation Minuteman (AW Oct. 29, 1962, p. 63) and again pursues in the Improved Minuteman system—company engineers have a computer which does away with most of the ground support equipment and tightly controls what little is left.

The computer will be able to communicate directly with the launch control facility through the Sylvania secure communications system that connects Minuteman silos with the control facility. This eliminates most of the ground data processing equipment necessary in earlier Minuteman wings. A consequent increase in the number of silos a single launch facility can control is a possible secondary advantage.



MOCKUP of guidance section of Improved Minuteman ICBM being developed by Autonetics reveals that flight control electronics, as well as digital computer and gyro stabilized platform electronics that would normally be expected, are upstage. General purpose amplifier utilizes semiconductor microcircuits.

In the earlier Minuteman system the missile computer checked out only missile-borne functions, getting its signals to do so from ground equipment in the silos. It reported gross results of a number of go-no-go tests to the ground gear.

Obtaining silo status information, such as the nature of silo environment, water level at the bottom of the silo and position of the silo doors and controlling ordnance devices was the duty of separate ground equipment supplied by Boeing, alternate Minuteman prime contractor.

The computer in Improved Minuteman now assumes these duties. Secure commands come directly from the outside world and the computer commands the remaining ground equipment. Ground test equipment now primarily supplies the "missile" to turn on ground power to the missile by throwing a power contact under computer command.

Additionally, the computer tells a ground scanner, or electrical stepping switch, how and when to scan in obtaining silo status information. The scanner gives the computer go-no-go signals which the computer includes in its status report of 60 items examined in the silo.

For the earlier Minuteman systems, Autonetics supplied two drawers of equipment, known as a coupler, which would accept commands from a data processor and the Boeing equipment and put these in a format suitable for instruction of the computer. It also monitored the computer.

With the ability of the computer to talk directly with the communications system, the coupler, the ground data processor and the Boeing gear are unnecessary. Thus simplifies maintenance, tends to increase reliability by reducing the quantity of equipment and offers greater flexibility. Any additional commands or deletion or alteration of commands requires only a change in the program of the missile-borne computer.

Ground equipment now consists of a single drawer "signal converter" completely under control of the missile computer. It contains the previously mentioned scanner, the contactors for throwing power and some sequencing circuitry to turn the missile on initially. In addition, there are two portable suitcases of equipment, containing a small tape reader and control panel, for inserting specific data on the missile's assigned target in the computer memory.

After the missile is lowered into the silo, and targeting information transferred to the computer, personnel can remove the suitcases, leaving the single drawer of equipment as the silo's principal ground equipment. Previously, insertion of targeting information was done by a truck-mounted programmer that was driven from silo to silo (AW Nov. 5, 1962, p. 79).

Using microcircuitry in the single drawer of ground equipment reduces its size and weight, but—more important—permits the grouping of circuit functions on easily accessible single module boards, thus easing troubleshooting and maintenance of what ground equipment remains.

Besides its expanded functions, the computer has its bread and butter duties like the earlier Minuteman missile. It solves the basic guidance-to-target equations, based on information supplied to it by attitude and velocity signals obtained from gyros and accelerometers. It generates steering commands for the missile's flight control system. It controls staging and thrust termination for each of the missile's three stages and determines when it is safe to provide pre-arm signals for the warhead, when to release penetration aids, etc.

In the silo, the computer provides continuous checkout of the missile and periodically performs detailed performance and calibration tests. It also counts down the missile prior to launch. Over 99% of its many years of lifetime are spent checking, rechecking and simulating.

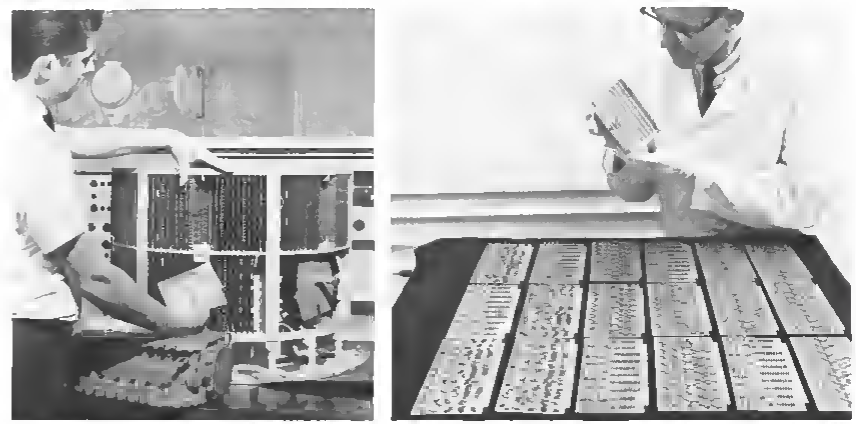
To achieve Improved Minuteman goals of higher accuracy, increased range and payload and greater flexibility and reliability requires that the missile-borne computer be functionally more complex. If the new system were built with the same types of avionics components and packaging as employed in the first versions of the computer, the added complexity would vitiate any reliability improvements.

This can be inferred by looking at the computer itself. The earlier Minuteman computer systems contained a total of 89 circuit boards (4 in. x 8 in.) including the power supply, a magnetic disk memory, a cable harness of considerable size and complexity and a shell-like frame.

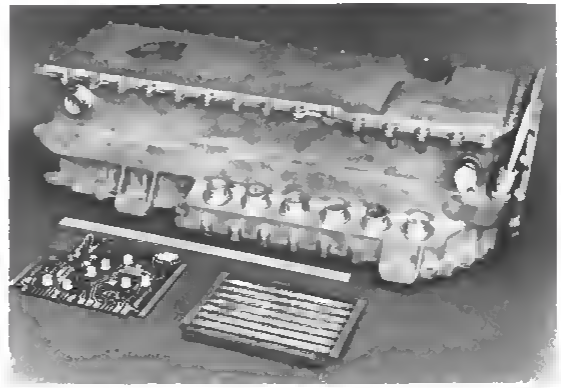
Using the same component and packaging design techniques to expand the computer to twice its previous capability to enlarge its performance and flexibility and reduce silo equipment would substantially boost the size and weight of the computer. Additional necessary components, boards, interconnections and harnessing would diminish the machine's reliability. The complement of circuit boards alone, according to Autonetics' calculations, would swell to 109.

Instead, the company elected to implement the system wherever possible with semiconductor microcircuits and, where these were not applicable, with related microcircuit techniques if at all possible. Its decision was motivated by the belief that semiconductor microcircuits would improve reliability and, as secondary benefits, would offer savings in size and weight and possibly cost.

The basis for Autonetics' expectation of increased reliability is that microcircuits, fabricated by silicon planar techniques on a single substrate, will require significantly fewer process steps than comparable circuits made of discrete components. With fewer process steps, control can be tighter and reliability improved. Although fabricating



DIMINUTION IN SIZE of Improved Minuteman guidance computer (extreme foreground, left) is apparent when it is compared with earlier Minuteman computer employed in missiles of Wings 1 through 5, contained on semi-circular structure. Circuit boards of newer computer (note one being held) are smaller than those of previous computer and fewer in number. Single Improved Minuteman circuit board, right, performs same function as the 18 larger circuit boards of the type employed in the guidance computer of earlier versions, which used discrete conventional electronic components. Newer computer performs added functions.



IMPROVED MINUTEMAN ICEM, guidance-checkout computer recently assembled by Autonetics Div. of North American Aviation, associate prime contractor for the missile's guidance and control system. In left foreground is aluminum circuit board from computer power supply. To right is a typical logic section multilayered circuit board containing a distinct function, such as analog-digital converter, clock, etc., composed of semiconductor microcircuits and discrete components

a complete microcircuit requires more steps than an individual transistor (in one typical case, 22 steps instead of 14), the single microcircuit can replace several transistors, diodes, resistors and capacitors.

In addition, there is less soldering, less over-all case area, fewer hermetic seals and fewer leads—all potential sources of avionic component degradation or failure.

Autonetics engineers also tried to reduce the number of different types of circuits employed throughout the system and where possible to use common circuits in the computer, the inertial measuring unit, flight controls, etc. In fact, the company settled on about 20 semiconductor microcircuit types for use throughout the system, supplemented by discrete components and screened microcircuits (AW May 14, 1962, p 95).

Improved Control

The advantages of this are severalfold. It permits the microcircuit supplier to concentrate on fewer process steps thereby improving his control and attaining higher yields and resulting lower costs. With tighter control, there should be higher reliability and, with larger quantities of fewer circuit types, more opportunity to get meaningful statistical reliability data. Field maintenance and logistics also should be simplified.

On the other hand, these benefits must be traded against the surrender of the designer's freedom in picking the best possible circuits in different portions of the system and the pressure of an accelerated schedule under which the Improved Minuteman guidance and control system is being developed.

Of the 20 semiconductor microcircuits in the program, some are digital circuits, a few are analog and others that may be used as either analog or digital circuits. There are two power circuits. Four digital circuit types account for about 80% of the total quantity—about 160,000 microcircuits—planned for the present phase.

Complete System

Complete Minuteman guidance and control system will consume slightly in excess of 3,000 semiconductor microcircuits, the computer taking roughly two-thirds of this figure (1,950) to satisfy over 93% of its avionic component needs. The flight control system uses 250 semiconductor microcircuits which account for over two-thirds of its avionics component requirements. The inertial unit may use about 200 microcircuits of this type, somewhat less than half its avionic component requirements.

With the exception of a power switch, all of the semiconductor microcircuits are packaged in a flat rectangular case, ¼ in. x ¼ in. by [illegible] in. in height. The power switch is in a metal can, approximately the size and shape of a common nickel with flat leads protruding at 90-deg. angles from the periphery of its case. The interconnection technique linking the microcircuits differs depending on whether the parts appear in the guidance computer, the inertial platform avionic package or in the flight controls.

Like its predecessor, the new Minute-

Almost ready: a new missile for the Navy

It's the A-3 Polaris — third version of America's most successful deterrent weapon system. Though it carries a bigger payload for a full 2500 miles, it fits into the same submarines as the 1200-mile A-1 and 1500-mile A-2. ■ This powerful weapon can be launched from surface ships, too, as demonstrated by this recent test shot from USS Observation Island. A Polaris launch-and-control unit installed in the cargo hold can turn a fast freighter into a mobile missile base, allowing our allies to build up their own world-wide deterrent at minimum cost. ■ The mighty A-3, now in advanced flight test and scheduled for active duty in mid-1964, will enable Polaris to be launched from a much vaster area of ocean, and to reach any target on earth with unerring accuracy.

Lockheed

Lockheed Missiles and Space Company, Sunnyvale, California • A Group Division of Lockheed Aircraft Corporation

man computer is a general purpose serial machine having a 27 bit word format, of which 24 bits are reserved for computation.

Its clock rate is the same as that of the earlier machine, 345.6 kc.

The memory unit has a 6,912-word capacity, more than double the 2,985 words of the earlier Minuteman machine. Yet despite the increased memory and circuit capacity which enable the computer to perform its expanded functions, the newer machine is smaller and lighter and requires less power. It weighs 36.5 lb., compared with 61 lb. for the earlier machine and it occupies less than 0.4 cu. ft. of volume, roughly a fourth that of the other machine. The dimensions of the envelope in which the computer will fit (about 0.7 cu. ft.) are 20.5 in. x 10.3 in. x 5.8 in. in height.

The computer is contained in a cast aluminum case, which has a hollow core running along its length and through which a liquid (water plus an inhibitor) is pumped for cooling the machine.

It is divided into three sections: a memory section housing a rotating magnetic disk driven by a 6,000 rpm synchronous motor, plus five memory circuit boards; a logic input/output section in the center of the case, containing 16 circuit boards; and a power supply occupying the final third of the case, and sealed from the remainder of the machine.

To increase memory capacity, Autonetics engineers developed a magnetic disk with a double headplate, one on either side of a 4-in.-dia. disk, and with it special read and write heads. The disk diameter is 1 in. smaller than that of the first Minuteman machines, and the complete memory occupies less space than the previous one.

All of the semiconductor microcircuits and most of the discrete avionic components in the computer are mounted on 4.12 in. x 5.2 in. multilayered etched circuit boards, each having the capacity for carrying a maximum of 180 microcircuits on both board faces. These are surface mounted on 13 mil gold plated copper strips, running in patterns along the length of the faces of the board. Heat generated in the microcircuits is conducted down the strips to the walls of the machine and removed by the circulating liquid coolant.

Avionic parts are so arranged that each board corresponds to a particular function, i.e., logic, analog-to-digital converter, etc. No special effort was made to maximize parts density; parts density for these boards being about six microcircuits per inch square.

Each memory and logic section circuit board contains a mixture of microcircuits and discrete components, with some boards in the logic section

almost exclusively microcircuit with the exception of a decoupling capacitor and others predominantly discrete components.

Sixteen boards separated by a spacing varying from 0.4 to ⅝ in. comprise the logic input/output section. These are made up primarily of digital circuits. The 16 comprise nine logic boards, two multiplexers, an input/output board, an analog-to-digital converter, a digital-to-analog converter, a clock and a memory jumper board.

The boards in the logic input/output section are interconnected by a single multilayered master interconnect board that is a solution to one of the most vexing problems in microcircuitry packaging—finding an effective means of interconnecting the hundreds of leads from the circuit boards. The single master interconnect board replaces the maze of wires of a wiring harness, and without it much of the size and weight improvement gained with microcircuitry would be lost.

Master Interconnect

The master interconnect board is roughly 8 in. long and has mounted on it 16 rows of 160-pin connector receptacles on 75 mil centers into which edges of individual multilayered circuit boards are inserted. The connectors are developed for the program by Amp, Inc.

Another half dozen specially developed input/output hermetically sealed 61 pin connectors, visible on the outside of the computer case, had to be developed for this application, in this case by Deutsch Co. The connectors are on 75 mil centers.

On the circuit board edge opposite the one which inserts in the interconnect board is another row of connector pins to which electrical connection can be made for test or checkout of the computer when the top of the case is removed.

Memory Circuits

The parts on the five memory circuit boards are combinations of discrete components and analog-type semiconductor microcircuits which function as a read/write subsystem. Memory boards are interconnected by a board at the top of the computer (opposite from the logic section interconnect board) and their test points are available when the bottom cover of the machine is removed.

The computer is sealed in a gas atmosphere and designed to stay sealed for many years of shelf and operational life. For maintenance, the top and bottom covers can be removed, test points checked, faulty circuit boards located and removed in minutes after unscrewing board screw locks. Removing the

memory, the most difficult part to take out, requires less than one hour after the computer is on the bench.

Company engineers who assembled and are testing the machine say they have encountered normal noise and cross coupling problems but report the machine has gone together very well, almost "as if we had been building this type of machine for years."

Microcircuits will cut the size and weight and increase reliability of the inertial measuring unit and perhaps indirectly help achieve one of the prime goals of the system—higher accuracy. This may be realized by adding servos, regulators and more circuitry to get more precise power supplies and making changes on the inertial platform, partly made possible by savings provided by microcircuitry.

While similar in many respects to the platform of the earlier Minuteman missiles (AW Nov. 5, 1962, p. 75), the inside-out gimbal configuration of the earlier system will be reversed to obtain better rigidity. The platform again is stabilized by two dual-axis free rotor gyros, one providing pitch and roll axis reference and the other giving heading reference. The number of dual-axis level detectors, whose functions include monitoring of the platform's integrating accelerometers and performing periodic calibrations, will be raised to six to increase targeting capability.

Some microcircuits will be mounted directly on the stable element to reduce the number of wires coming off the platform, minimize torque difficulties and electrical interference and generally to shorten leads.

In the inertial measuring unit ceramic printed circuits which the company fabricates by a mechanized process (AW May 14, 1962, p. 95) will be used along with semiconductor microcircuits. The packaging scheme employed allows leeway in the event any of the more difficult analog semiconductor microcircuits are not available on schedule. Some of the basic avionic modules for the inertial package are still in the breadboard stage, suggesting that the computer development is paced ahead of the inertial system. The stable element is available though, according to Autonetics.

The inertial avionic package will consist of 37 modules containing 25 different types of circuits. Each module case, made of light weight magnesium, measures 4x2 in. and about 1¾ in. in depth. The unit opens clamlike and can accommodate a large number of ¾ x 1.5 in. ceramic substrates which slip into the module and are interconnected at the bottom by an interconnect board.

In designing the modules, Autonetics reserved a single substrate for each semiconductor microcircuit and for

PROBLEMATICAL RECREATIONS 194

The algebra teacher wrote on the blackboard a quadratic equation of the form $x^2 - Ax + B = 0$. In copying this a careless student erroneously transposed the two digits of B as well as the plus and minus signs. However, one of the roots was the same. What was this root?

—Contributed

Further broadening our capabilities in the electronics systems field for defense is the latest addition to our operations, the Aerospace Research and Engineering Departments of General Mills in Minneapolis. This laboratory is doing highly advanced research and development work in upper atmosphere physics, microbiology, and the communication sciences. One of their most recent projects, now in the final stages of development, is a two-man undersea research vehicle for the Navy. The vehicle will permit deep submersion for a closer look at the ocean's bottom.

ANSWER TO LAST WEEK'S PROBLEM: 361 tons.

each microcircuit designed equivalent backup circuits made of discrete parts and/or silk screened passive components which could be mounted on an alternate single substrate.

While this was done at the expense of parts density, it ensured that in the event a given semiconductor microcircuit was not available in time, the substitute or backup circuit could replace a substrate reserved for the semiconductor microcircuit.

As it turns out, four of the six types of semiconductor microcircuits scheduled for the inertial package will be ready while the remaining two—a demodulator chopper and one of two general purpose amplifiers—may give way to their backups.

An engineering model of one of the two missing types was being evaluated here recently, however.

In an important departure from the earlier system, most of the flight control electronics are contained in a control system amplifier assembly located with the guidance system upstage, to considerably simplify maintainability, permitting easier access to flight control electronics. Previously, the control electronics were located near the nozzles of their respective stages.

Avionic parts—including all semiconductor microcircuits—will be surface mounted on magnesium-lithium alloy boards, stacked one above the other and housed in a magnesium casting. The unusual alloy was chosen as board material because of its light weight (30% lighter than aluminum) and its superior vibration characteristics.

There are seven boards in the assembly—three containing ordnance switches, three servo loops and one for trimming resistors needed for alignment—and a block for the power supply. This leaves only secondary power supplies, pickoffs and the pair of angular accelerometers on the second stage to provide vehicle attitude signals. What avionic parts are downstage are usually discrete micro components.

All servo loops are mechanized with semiconductor microcircuits using a general purpose amplifier, power switch and other switching units.

With the new arrangement, guidance computer commands to the flight controls to displace nozzles on the first or third stage will now be routed to the proper servo amplifier in the nearby flight control assembly upstage rather than to the nozzle control units downstage, as in the earlier Minuteman. Like the earlier system, servo output will control solenoid valves near the nozzles, admitting hydraulic fluid to actuators to displace the nozzles.

The second stage differs from the others and from the earlier Minuteman. It uses liquid (Freon) injection thrust control and has a special hydraulic sys-

tem which operates large valves that control Freon secondary injection. The control system will also monitor flow rate. It too derives its commands from the computer.

Boards for the control system amplifier assembly are currently being fabricated.

The use of semiconductor microcircuitry in Minuteman could have significance that transcends its application to the system, important as that may be. For Minuteman is one of the earliest and largest systems to be committed to this approach, and it could serve as a catalyst for other military systems to follow.

Similarly, its success, which Autonetics is already hailing, could have an important bearing on the fortunes of Minuteman microcircuit suppliers in the competitive semiconductor situation ahead, just as the earlier Minuteman component reliability program helped its successful semiconductor participants through the recent rough period. It assisted them in refining their processes, in locating failure modes in their components and consequently in enabling them to produce better products and in providing a sizable market for them.

Protracted Difficulties

On the other hand, any severe and protracted process difficulties conceivably might tie up supplier engineering personnel and facilities, denying them an opportunity to gain and hold favorable competitive positions on other programs. It is no surprise that within the avionics industry the progress of this program is being watched attentively.

As things now stand, there are four microcircuit suppliers, with Texas Instruments and Westinghouse dual sources for 19 of 20 circuits in the program, according to Autonetics. Each of them is expected to supply about an equal number of microcircuits and between them they are under order to provide the overwhelming bulk of microcircuits. General Electric is supplying a low level switch, for which TI and Westinghouse are alternate sources. Radio Corp. of America is making a power switch for which it presently is sole source.

Microcircuit Deliveries

Initially, Autonetics concedes, suppliers did have some process difficulties but last month microcircuit deliveries reached about 1,450 a week, a substantial start toward a 4,400 per week delivery rate goal which is targeted for December.

Autonetics says there was readjustment in microcircuit specifications, both a relaxation in some cases and a tightening in others, but never with any sacrifice in the over-all weapon's specifications. This readjustment is part of a natural evolution which it cites as being similar to one it went through on the previous Minuteman effort. In general, the specifications were deliberately made tight to push technology as far as possible.

In the original bid requests to industry, the company asked potential suppliers to produce all microcircuits in single chip form—that is, each microcircuit fabricated within a single silicon die. Some of the circuits were extremely difficult at that stage of technology—requiring both NPN and PNP transistors, which necessitate complicated multiple diffusions. Sources in industry contended at the time and even more recently that this could not be done within the time span requested by Autonetics.

The company says it would not have disqualified any bids which proposed a multi-chip approach on these difficult circuits, although bidders offering this as an approach would have lost a few points in a competitive point evaluation. The companies selected to supply these circuits did propose alternate single and multi-chip approaches, the latter under the pressure of a tight schedule.

As it turns out, three microcircuits, generally the analog NPN/PNP types,

such as the two identified earlier with the inertial platform, will be used in multi-chip form, at least on initial copies of the new system. Some feasibility models of other microcircuits of this type have been made, but there is one circuit which none of the suppliers has yet delivered in single chip form.

The flat microcircuit package with the narrow dimension (⅛ in.) has presented some problems, particularly in maintaining hermeticity and in having leads pull out.

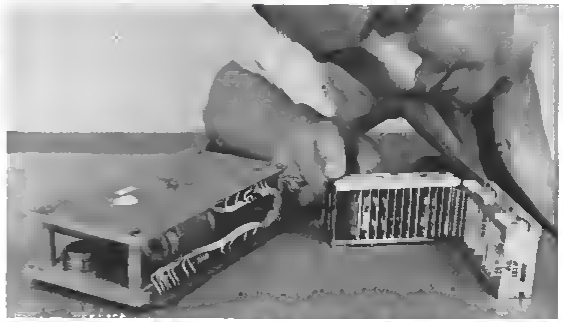
But all of these difficulties, according to Autonetics, are no more serious or insuperable than comparable problems it encountered in shifting from vacuum tubes to transistors in the Navaho missile and its Verdan computer, the precursor of the Dana-Scar inertial guidance computer and the operational Minuteman computer.

While the company has not had the funding or the time to conduct as exhaustive a reliability program with microcircuits as it did with earlier Minuteman avionic components, microcircuits are still subject to careful testing.

They first undergo the usual vendor design tests which determine whether the die is satisfactory. After microcircuits are completed they undergo the first of a series of acceptance tests. First are tests for mechanical degradation to see if the circuits can withstand vibration, temperature, lead bending, etc. They then are subjected to a series of 25 qualitative electrical parameter measurements. Subsequently, they are put through 500- to 1,000-hr. burn-in tests and the degradation and electrical tests are repeated.

Critical electrical parameters are recorded, and parts and records shipped to Autonetics. Here, the same 10 parameters are rechecked and data inserted in punch cards which are compared with the originals from the vendor.

Soon, Autonetics expects to launch a component quality assurance program, a method of upgrading devices, in which the vendors will be expected to test parts to disclose failure modes, analyze these and eliminate them from their devices. This program will be similar in intent to earlier reliability program on Minuteman.



DOUBLE AMPLIFIER MODULE (right), slated for use in the avionic package of the inertial platform of Improved Minuteman, is shown next to larger module from earlier Minuteman system, which it replaces. The larger unit occupies 64 cu. in.; new module 14 cu. in. Ceramic substrates mount semiconductor microcircuits, discrete and silk screened components.

We put 900,000 holes in this wing to make it fly better

You can't see them. But they're there. And they help solve one of the most baffling problems in the history of aviation.

The problem centers around a thin boundary layer of air that flows next to the surfaces of an airplane in flight. This air becomes "turbulent" as it passes over the wings, causing a sharp increase in friction drag—drag that robs the plane of speed, range, and efficiency. This turbulence has nothing to do with bumpy air; it occurs even when the plane ride is as smooth as silk.

To overcome this problem, Northrop has conducted a 14-year research program, and has developed a system called Laminar Flow Control. Row after row of paper-thin slots are put in the wings of an airplane. Underneath these slots are pinsize holes. A pumping system inhales the boundary layer air through the slots and holes and expels it to the rear. Swoosh! Boundary layer turbulence is virtually eliminated.

Laminar Flow Control will make it possible to extend the range, endurance, or payload of large aircraft by 50% or more—with no increase in fuel consumption. Best of all, perhaps, is that it can be added at very nominal cost. And this initial cost is quickly recovered by economies of operation.

Laminar Flow Control has been applied by Northrop to two U.S. Air Force jet aircraft, which are designated X-21's. These are now being flown to demonstrate the new technology. Results of these tests should radically alter the fundamental concepts of large plane design, economics, and missions.

NORTHROP

Solutions to Cost Overruns Recommended

Washington—Former Defense Dept and space agency official has recommended that the government establish its own group of financial experts to obtain more realistic estimates on costs of developing new weapon systems to reduce the overrun problem.

Richard E. Horner, former assistant secretary of the Air Force for research and development, and later associate administrator of National Aeronautics and Space Administration, said both industry and government must share responsibility for the present "infamous cost overrun problem." Horner, now a senior vice president for Northrop Corp., said the overrun situation arises because of overly optimistic industry bids prompted by the need for new business and the difficulties faced by the military project officer in obtaining program approval.

Horner said even defense contractor has a group of skilled cost estimators and that the government could organize a group with comparable ability that would have "superior objectivity."

Speaking at a National Rocket Club meeting here he recommended that bid price be completely removed from proposals intended for source selection where the contract will be cost-plus-fixed-fee. While acknowledging that government administrators say price is not now a significant factor in such CPFF competitions, Horner said public pressures make it difficult for a contracting officer not to select the low bidder when all bidders are experienced and responsible companies.

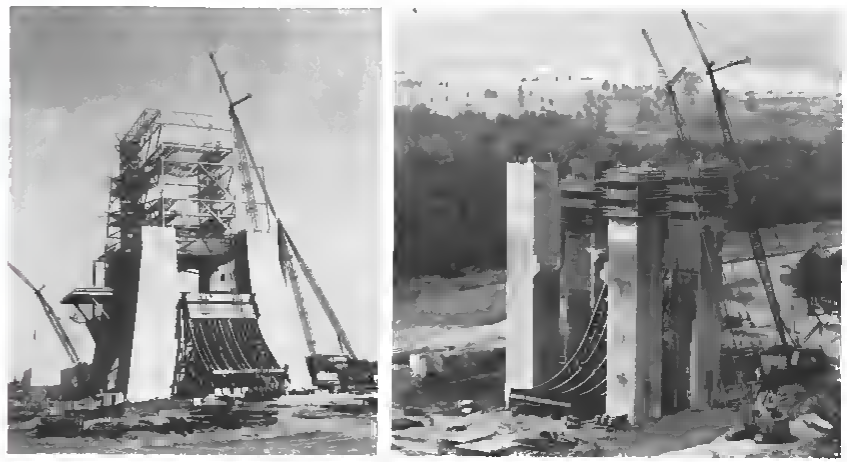
He said industrial management believes that the quality of being low bidder is important and usually acts accordingly. Price should be a major determinant in contractor selection only in those fixed-price and incentive fee contracts where the contractor is risking his own resources on the basis of his own performance, he said.

Horner called for increased discrimination in the selection of contractors invited to compete on proposal efforts, to reduce the "gross waste of scientific and technical manpower in both industry and government" involved in proposal preparation and subsequent evaluation. Development contracts should be placed on the basis of "demonstrated capability to do comparable work . . . as opposed to a capability to write high-quality proposals."

Contractor evaluation procedures and multi-step source selecting, including program definition phase type contracts "if properly administered hold great promise for substantial improvement," Horner said.

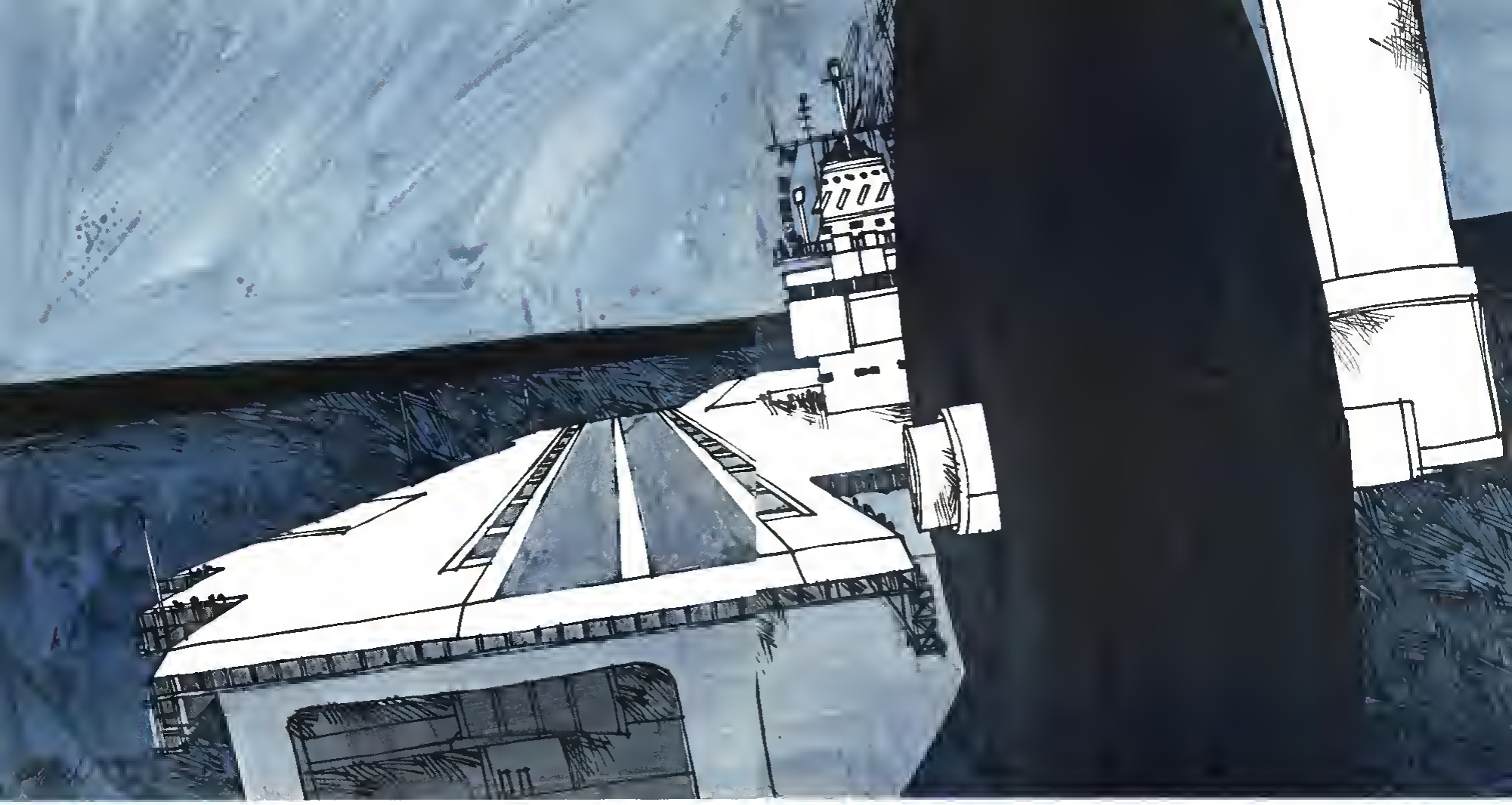
Horner said elimination of price as a competitive factor in CPFF development programs would remove the incentive to correct a too-low bid by renegotiating changes. This was a reference to contractors sometimes underestimating the cost and time of doing the job with the intention of later increasing contract price and delivery schedule by pointing out the need for changes in the original program objectives.

He also pointed out that the government policy which limits profits, while



S-1C and F-1 Test Stands Near Completion at Marshall

Major test stands for National Aeronautics and Space Administration's Saturn S-1C (left) and F-1 engines are nearing completion at Marshall Space Flight Center, Huntsville, Ala. The S-1C stand has four 144-ft.-tall concrete pedestals, each 47 ft. square at the base. A 122-ft.-tall superstructure rises above the legs and will serve as the mount for the stage. The platform between the left pedestals of the stand is a movable working level which can be swung toward the center of the stand to allow workmen to service the five F-1 engines which will power the stage. The F-1 test stand (right) will be used to static test individual powerplants. The F-1, being built by Rocketdyne Div. of North American Aviation, delivers 1.5 million lb. thrust. This stand will be more than 200 ft. tall. The flame deflectors for both stands will be cooled by water deluge.



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treating much of the expense of making new proposals as an allowable item of expense, has encouraged many companies to compete when they have little chance of success.

Technical overhead, the largest single item of expense in making new bids, also is an allowable item of expense, as is background work necessary to prepare proposals. This "offers a strong motivation for industry to respond to far more proposals than . . . if the system did not create the effect of industry spending government money . . . to sell its products to government," Horner said.

He said that if such expenses had to come out of company profits or CPFF fees, companies would be more selective in their bids.

"This," he said, "would substantially affect the source selection system and the problem of cost performance."

Horner said many products now developed under CPFF contracts would be independently developed or explored, at least through the feasibility and breadboard stage. Under these circumstances, the government then could buy such systems using negotiated fixed-price and incentive contracts, and the potential of profit motivation would become a significant influence on performance.

Presumably, such a change in Defense Dept. and industry procedures would require an increase in the fee or profit allowed under defense contracts to provide funds for company-funded research and development and the proposal effort.

AFSC Seeks Advanced Programs Streamlining

Washington—Research and Technology Div. of Air Force Systems Command has taken steps to streamline its planning and contracting for exploratory and advanced development.

In addition, management review techniques will be simplified to fit the relatively modest size of its research contracts, which average $100,000. The division administers about $750 million in this type of contract throughout the course of each year.

Procurement officers from the division's centers and observers from AFSC headquarters met at the division's Bolling AFB headquarters here recently to standardize procedures. The division, under the command of Maj. Gen. Marvin C. Demler, came into existence a little over a year ago and only recently reached its full size by taking over the last laboratories from other Systems Command divisions (AW Sept. 2, p. 24).

The principal problem, according to Gen. Demler, is that the laboratories,

which are scattered from coast to coast, have been tied to organizations whose procurement policies have been oriented toward massive systems.

He said he would like to reduce the division's time from idea to contract to four months or less, compared with the 18 months sometimes required for large systems.

The conference chairman, Lt. Col. Buford Briggs, said that this was the first effort within the Air Force devoted exclusively to the purchasing problems of laboratory organizations. Previous meetings have dealt with the problems of much larger developmental and systems procurement.

Closer Checks

The conferees were told that, in line with the Armed Services Procurement Regulations (ASPRs), closer management checking was necessary, but it was not necessary to use such complicated systems as PERT, which require large staffs to operate them.

The AFSC division plans two moves which are designed to make it easier for a contractor to submit a proposal and to avoid including objectives in a proposal that are unneeded or impossible to fulfill.

First, the language used in requests for proposals will be made as simple and straightforward as possible. Sometimes the language will have to be in general terms because it is the contractor's approach to the solution of a problem that is wanted and that can only be defined vaguely.

Second, firms that submit proposals that are generally acceptable, but contain promises that would be difficult to fulfill, will be told so. The division wants to avoid over commitments by its contractors.

Procurement Offices

Every center under the division eventually will establish its own procurement office.

The Electromagnetics Laboratory at Rome AFB, N. Y., already has this capability, as do some laboratories at Wright-Patterson AFB, Ohio. Others, however, have been dependent on the divisions of AFSC for their procurement services.

These will develop their own capabilities along the lines established at the conference.

The division's field organization now includes, in addition to the Electromagnetics Laboratory, the Weapons Laboratory at Kirtland AFB, N. M., the Rocket Propulsion Laboratory at Edwards AFB, Calif., and the following at Wright-Patterson AFB: Materials Laboratory, Flight Dynamics Laboratory, Propulsion Laboratory, Avionics Laboratory and the Systems Engineering Group.

PIPER WILL INTRODUCE new version of the Comanche, powered by 400 hp Lycoming IO-720 engine, in mid 1964, the company says.

Piper Studying Standardized Parts Plan

Hollywood, Fla.—Piper Aircraft Corp. is studying increased use of standardized parts and assemblies and a program of cost effectiveness in an effort to hold down aircraft and electronics equipment prices.

Howard Piper, vice president for research and development of Piper, told dealers and distributors, at the company's annual sales meeting here recently, that one of the company's major aims was to hold prices down.

Somehow, as the years go by, we have to find a means of making airplanes more acceptable to the public from the cost standpoint," Piper said. "We haven't made much progress on this yet except in a few minor areas and the added complications that we work into the airplanes in the way of real or so-called improvements—such as sound proofing measures, which are real improvements, and fuel injection, which is a questionable one—in many cases tend to more than offset any economies we might be able to effect."

Avionics Prices

Piper said that the company would also continue to try to lower prices of light airplane avionics equipment. He called this an uphill struggle because of the tendency of prospective purchasers to equate price with quality.

The company may attempt to hold down the cost of aircraft by standardizing such items as door handles, switches, lights and possibly assemblies as large as entrance doors themselves, according to other company officials.

This would allow considerable savings in manufacturing costs and could be done fairly rapidly, they explained.

For the present, Piper anticipates a 21% increase in sales in the forthcoming year while holding the price line on all models.

Piper said that interest in the all glass fiber Papoose experimental aircraft still is high, but that the aircraft is several years away from a marketable status.

He said the company's Research and Development Center at Vero Beach, Fla., still is encountering problems with the machine.

Gloss Fiber Expansion

Other sources at the meeting indicated that a major problem impeding the development of the Papoose is a tendency of glass fiber to "grow" or expand over a period of time. Piper also is reported still to be searching for a satisfactory resin to apply to the cloth laminates.

Finally, there is some indication that glass fiber at present may not be able to compete with metal in weight or manufacturing cost.

The company announced that its 400-hp. version of the single-engine Comanche (AW Apr. 1, p. 97) would be introduced to the market in mid 1964.

The Comanche 400, powered by a Lycoming IO-720 8-cylinder, direct-drive fuel injection engine, is expected to cruise at 210-215 mph. at 75% power and 7,000 ft. altitude. Gross weight is 3,600 lb. Fuel capacity has been increased to 130 gal. from the 90 gal. capacity of earlier Comanches, giving it a duration of 6 hr. at cruise power. Propeller is a three-bladed, constant speed Hartzell.

The aircraft will be produced at Piper's Lock Haven, Pa., factory. Wings and fuselage will be similar to the Twin Comanche, including the Twin Comanche's double sound-proofing system. Stabilator is the same as on the Aztec.

The new Comanche, described by company officials as a "four-place P-51 Mustang" is expected to reverse or at least arrest, the sharp drop-off in sales of heavy single engine retractable gear aircraft experienced in the light aircraft market during the past several years.

J. W. Miller, director of marketing, said the firm is looking to the Comanche 400 and the new Cherokee 235 (AW Sept. 2, p. 57) to pace Piper's growth this year. He noted that for the past several years all manufacturers of heavy, single-engine, retractable-gear aircraft—with the sole exception of Mooney Aircraft, Inc.—have experienced a noticeable decline in sales of these aircraft.

Cherokee 235 Floats

Howard Piper told the more than 800 persons attending the meeting that the Cherokee 235 probably would be the next aircraft in the company's line to be certificated for operation with floats and that addition of a supercharger to the Comanche 400 was "not inconceivable. Performance is what people want in this category," he said.

Piper also mentioned that the company was interested in the two-place trainer/sport plane market and said there were several other projects under way. These possibly include a pressurized twin-engine aircraft if a suitable pressurization system can be developed.

William T. Piper, Jr., executive vice-president, Miller and other Piper offi-

cials were optimistic about market prospects for the fiscal year which began Oct. 1. Piper predicted that 1964 would exceed 1960—the best year to date for the light aircraft industry—in sales volume. He forecast sales of about $46 million in Fiscal 1964, compared with an estimated $38 million for the fiscal year just ended.

Miller said the company is planning to increase its present 20-25% share of the light aircraft market by five percentage points over the course of the next five years.

Another factor which the company may be considering in the next few years is a reduction in the number of single-engine aircraft in its line. Counting the Comanche 400, Piper now is offering nine different single engine aircraft, plus two versions of the Pawnee agricultural airplane.

PRIVATE LINES

Aero Commander, Inc. of Bethany, Okla., has become a division of Rockwell-Standard Corp. of Coraopolis, Pa. Thomas J. Harris has been named vice president and general manager of the new division. Aero Commander has operated as a Rockwell-Standard subsidiary since 1958.

U. S. Dept. of Commerce is offering the initial Project Little Guy report to the public at $2 per copy. The report, written by Matrix Corp., was released last Feb. 15 (AW Feb. 18, p. 115) and deals with early studies to develop a less complicated light aircraft cockpit. Orders should be addressed to Office of Technical Services, Dept. of Commerce, Washington, D. C., 20230.

Southwest Ammotive Corp. of Dallas has reported a 16% gain in sales volume for the fiscal year ended May 31 over the previous year. Total sales were $15,755,305 and net income was $495,968, an increase of 13.1% over the previous year. Per share income was 47 cents, but was reduced to 33 cents per share by taking a write-off charge of $147,391 to reduce amortization of the company's Love Field facilities from 25 to 15 years.

Pre-production Beagle B.206-Y recently flew non-stop from London to Gibraltar—1,100 mi.—in 5 hr. 40 min., with reserves remaining for another 500 mi. Useful load was 1,410 lb. The aircraft, designed as a business plane, is being offered to the Royal Air Force as a liaison aircraft.

Atlantic Aviation Corp. has broken ground for a fourth hangar at its Wilmington, Del., facility and will increase its working space there by 214,000 sq. ft., including ramp areas. Company said the hangar and associated shop areas were being added to provide service capabilities for turbine-powered executive aircraft. Atlantic recently became U.S. distributor for the Hawker Siddeley DH-125 turbojet (AW Sept. 9, p. 27).

Federal Aviation Agency has certificated Hiller 12E-L helicopters for operation with a stability augmentation system. Type certificate covers Hiller 12E helicopters fitted with the company's electronic hydraulic stability augmentation system and a new "L" rotor system package. New rotor system increases gross weight by 300 lb. and useful load by 200 lb.

Safety awards to 205 business pilots who flew one million or more miles without accident during the past year were presented at the National Business Aircraft Assn. convention in Houston recently. Also honored were 152 pilots who flew at least 500,000 mi. without accident and 87 corporations whose aircraft flew at least one million miles safely.

Federal Aviation Agency is requesting student pilots to identify themselves as such when contacting FAA towers, flight service stations or other radio facilities. FAA field personnel have been instructed to provide students with such extra assistance as they may need.

Standard fuel capacity for the Fairchild F27F executive turboprop has been increased to 2,063 gal., giving the aircraft an unrefueled range of 3,000 stat. mi. Additional wing tanks containing 300 gal. also are available.

Tricycle landing gear for the Beech Super H18 executive aircraft will be offered as factory installed optional equipment by the manufacturer. Tricycle gear was developed by Volpar, Inc., of Los Angeles and has been marketed by them for the past four years. Price for the factory installation will be $22,950.

Mississippi Valley Helicopters, Inc. has been awarded a contract by the Interior Dept.'s Geological Survey calling for use of an experimental electronic triangulation method for the production of high precision maps. Method will call for a helicopter to hover over a position, using a hover sight positioning device to maintain a stationary position. An electronic reflector will be lowered from the helicopter and measurements made from a ground station to it. Work on the experimental technique is being done near Presque Isle, Me.

NEW CESSNA navigation/communications radio is shown mounted on a panel (top). Bottom is Cessna Nav-O-Matic 400 autopilot. Radio is available in either 100- or 360-channel communications versions and both have a 100-channel nav receiver.

Cessna to Market New ARC Radio

Combined navigation-communication radio system for light aircraft has been introduced by Aircraft Radio Corp., Boonton, N. J., and will be marketed under the Cessna trade name by Cessna Aircraft Co. of Wichita, Kan.

ARC is a subsidiary of Cessna. The system is designated the RT-514A by ARC and will be marketed by Cessna as an addition to the Cessna 300 series radio line.

Cessna also is adding a new autopilot —the Nav-O-Matic 400—to its line of electronics equipment.

The RT-514 includes two receivers and one transmitter. The communications receiver and transmitter is available in either 100- or 360-channel configuration. The 100-channel model includes standard frequencies from 118.0 through 126.9 and 135.0 through 135.9 mc. The 360-channel version provides for the frequency range between 118.0 and 135.95 mc. with 50 kc. spacing.

Both versions have a 100-channel navigational receiver with all VOR/LOC frequencies and an omni converter and indicator.

The unit is 6½ in. wide, 3⅜ in. high and 12½ in. deep. Only the power and antenna leads must be connected once the radio is installed in the panel. Provision for four additional audio amplifier outputs and a built-in squelch control for the communications receiver are included, as is rear lighting for all panel functions.

Cessna's Nav-O-Matic 400 autopilot provides command pitch control, wing stability and turn control. Altitude hold capability is provided through a pressure sensing device which detects altitude changes.

The autopilot also is capable of making automatic turns to a pre-selected heading, has heading lock capability and an omni coupler for radial intercept and tracking capability. It is transistorized throughout.

WHO'S WHERE

(Continued from page 19)

Changes

Dr Eberhardt Rechtin, assistant director Tracking and Data Acquisition—including Deep Space Instrumentation Facility (DSIF) activities California Institute of Technology Jet Propulsion Laboratory, Pasadena, Calif Also **William H. Bayley** manager of DSIF, **Walter K. Victor** chief Telecommunications Div, and **Joseph F Koukol** deputy chief, **Mahlon F Easterling**, chief Communications Systems Research Section, **Reed B. Harker**, chief Communications Systems Development Section

Michael F Maguire and **Thomas P Foly**, assistant directors of engineering Electro Optical Div Perkin Elmer Corp Norwalk

Joseph W. Ranitl nucleonic systems sales manager Systems Div of Giannini Controls Corp Duarte Calif

Dr Harry N Olsen, head Plasma Laboratories Northrop Space Laboratories Hawthorne, Calif Also **Dr Jay T Thomas**, director of physical sciences Northrop Space Laboratories and **Walter S Makush** chief of military systems Applications Engineering Section

William F Teichmiller general manager of the Pacific Div (Santa Ana, Calif), The Hallicrafters Co Also **Emory G Johnson**, special products manager **Jack M. Hollander** data systems manager

Wick Jackson, manager of reliability control Centaur program General Dynamics/Astronautics San Diego Calif

Mark K. Miller manager The Boeing Co s Pacific Test Center Vandenberg AFB Calif succeeding **Lionel D Alford**, reassigned to Boeing's Saturn Program, Huntsville Ala

Don E. Rogers, senior staff engineer to the vice president and general manager Engineering Div San Bernardino (Calif) Operations Aerospace Corp

Harold Gould general manager Pressure Vessel Div Menasco Manufacturing Co Burbank Calif

Jack G Real, chief development engineer Lockheed-California Co Burbank Calif succeeding **R. L Thoren** now director of engineering Also **J E Hawkes** chief engineer for the F 104 **W M Magruder**, chief development engineer SST

Carl Mandenberg director of materiel Aircraft and Industrial Div Lear Jet Corp Wichita Kan and **Paul O Momenteller** marketing manager Industrial Div

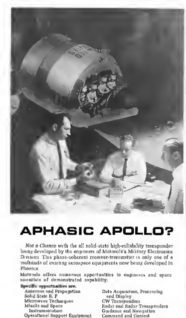
John H Quinn, Jr manager Structures and Aerophysics Dept Martin Co s Denver (Colo) Div

Robert Strauss manager Arnic Research Corp s Component Research Program Washington D C

George A Hatcher director of cargo/transport programs Fairchild Stratos Corp s Aircraft Missiles Div Hagerstown Md and **Charles F Murray** director of procurement for the division

Sidney Thurston, chief Advanced Underwater Systems, Northrop Nortair a division of Northrop Corp, Hawthorne Calif

J T Underhill director of engineering Space and Systems Div., Packard Bell Electronics, Los Angeles Calif



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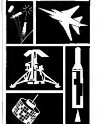

LETTERS

Family Fare Plan

I note with interest your article in the Aug 19 issue, page 39, concerning the family fare plan on domestic trunk lines. The idea is certainly in the best traditions of American business, stimulated by new and dynamic thinking. I believe however, that the increase in traffic will be even greater if the airlines consider the possibility of allowing families to travel separately at the reduced rate. In our day and age, despite safety statistics and despite political implications arising therefrom, the airlines should recognize that an accident is possible and that if a husband and wife or the entire family are traveling together the risks are too great and the consequences too catastrophic. For example, it is a common practice in large corporations to fly their important executives to conferences in separate aircraft. If it is good enough for individual executives of large companies, it is relatively as important for the two executives of the family household.

I am suggesting, therefore, that those who are looking for increased revenue as a result of first class fare traffic look into the possibility of allowing a husband and wife to travel "one airplane apart" and still retain this as a family fare.

Undoubtedly, it is feared that some people might take advantage of such a plan and defeat its original purpose. It is, however, difficult to justify a husband and wife traveling together while a family totally dependent on them is left at home. It makes one think twice about life insurance policies and wills to the extent that it kills the joy of a vacation plan.

JACK H. ARABIAN
Mattapan, Mass.

Industry Defense

Recent comments by MSC Deputy Director Walter Williams on the high rejection rate of aerospace hardware and similar comments over a period of time by Vice Adm. H. G. Rickover on hardware for the submarine programs, warrant considerable thought by leaders in both industry and government.

Admiral Rickover, with some justification, lays the blame on industrial management, who he says are more interested in getting new contracts than in seeing to it that the things they have already contracted for are done well. However, before we judge industry management too harshly, we should consider some of the barriers the government agencies have placed in their paths. The endless interference and red tape in operations, plus the very real responsibility of keeping the plant in work in a highly competitive industry under a very complex procurement system admittedly detract heavily from the time many managers would prefer to devote to supervision of development or production work. Furthermore several decades of Alice-in-Wonderland government-backed labor policies have in many instances put the individual worker beyond the control of management.

In view of the number of genuine problems faced by industrial management, it is unfortunate that leaders like Admiral Rickover do not devote more of their considerable talent and influence to creating a more favorable environment for the industries which serve their programs, and less to criticizing a group of men who are by and large dedicated, competent and performing well under difficult circumstances.

Mr. Williams and Admiral Rickover have raised an important issue which we in industry should take under very serious advisement. But I hope that at the same time responsible leaders in government agencies—along with their healthy criticism—will seriously consider what they can do to help industry managers to devote more time to assuring that the high standards of manufacture required by our space and military programs will be met.

RICHARD L. MELA
Cambridge, Mass.

Cooper (Cont.)

I have rarely seen so many cases of semantic confusion as have appeared in the numerous letters to AVIATION WEEK & SPACE TECHNOLOGY concerning the experiences of Astronaut Cooper in sighting various objects on the ground from his space capsule.

The basic confusion appears to center about the difference between detection and identification. In general the argument saying Cooper could not possibly have made these sightings states that the "resolving power" of the eye is approximately 1 min of arc. This is true when the phenomenon concerned is the ability to differentiate between two point objects which have an angular separation of 1 min of arc. However, in Cooper's case this is not the problem. In all instances where were mentioned by Astronaut Cooper he was detecting high contrast objects (single objects in the case of houses, cars and trucks) against a relatively uniform background. The high contrast was generally caused by reflection of sunlight from smooth surfaces or a dark object against a light background. It was maintained where the atmospheric haze was low (Tibet, desert areas). Cooper was not able to distinguish small low contrast objects or even large low contrast objects in many cases. For example, he was not able to distinguish Los Angeles in the haze (smog?).

Since the eye, as do most sensors, detects integrated energy over each rod and/or cone (resolution element), it is quite possible that an object with sufficiently high (or low) reflectance will be differentiable from surrounding terrain even though its angular subtense is much smaller than that associated with the detectability of two separate objects. For example, Cooper could differentiate between two cars only if they were separated by 200 ft or more. Similarly roads and other long lines (including smoke, rivers and boat wakes) were detectable even though their smallest dimension (that is, their width) is well below the two-object resolution threshold of the eye. This is because the human visual system integrates over the entire length of the line and thus is able to separate it as a distinct signal from surrounding noise-like terrain.

In many cases, of course, Astronaut Cooper possibly concluded, because of supplementary information such as the location of roads and the surrounding terrain, that the point objects he was seeing were trucks, automobiles, houses, boats, etc. It was not possible for him to independently identify the objects even though he could detect them.

As for the "lens" effect of the atmosphere as proposed by Mr. Strumbos in his letters of Aug. 12 (p. 118) and Sept. 30 (p. 106), some numerical precision is lacking. If Mr. Strumbos would carry his Sept. 30 argument to its logical conclusion he would discover that, given a refractive index for space of 1.000, a refractive index for air of 1.0003, and an effective thickness of the atmosphere of 30,000 ft., the apparent depth of the ground as seen vertically from the top of the atmosphere is only about 9 ft. less than if there were no atmosphere at all. This is hardly enough to cause any significant difference in an astronaut's visual capabilities.

To summarize then, it is quite possible for Cooper's sightings of relatively small objects on the ground to be explained by optical and visual phenomena which have been known for a long time. There is no necessity for quasi-magical explanations or any sort of super-normal capability to be ascribed to Cooper. The only thing new that Cooper's flight seems to have pointed out is the great extent of misinformation on phenomena with which any observant person (not to mention first year physics students) should be familiar.

JACK MATTHEWS
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TFX Conflict

The TFX controversy has been relatively quiet for several weeks. Perhaps the ashes need to be stirred and some fuel added, just to get things going again.

Maybe the reason that Boeing squawked so loudly when they lost the TFX was because the pressure was applied to the top side of their corporate toes for a change. Have they forgotten that the Martin B-51 could easily out-perform the B-47? What about the international toe-trodding when their Bomarc "shot down" the Mach 3 Avro Arrow? They should also be reminded of a previous competition with General Dynamics/Ft. Worth in which the very fine YB-60 was scuttled in favor of the B-52. From what I know, Boeing should be thankful that the cost/effectiveness boys didn't get a chance to pass on those choices.

ROBERT PEPPS
Rockford, Ill.

For reprints of this symbolic Artzybasheff illustration of an early Voyager concept, write: Avco, Dept. AW4-2, 750 Third Avenue, New York 17, N. Y.

Let's take a look. What's behind the cloudy veil of Venus? Or beneath the red sands of Mars? Or on the Moon's pock-marked plains? What's out there in space? NASA is finding out. With Voyager, the Venus/Mars orbiter-lander . . . with Gemini, the two-man rendezvous spacecraft . . . with Moon-bound Apollo . . . with Mercury, the one-man earth orbiter. NASA is extending man's vision to new frontiers in space. Focusing the keen minds of science and industry on the big "Out There." Inspiring studies and projecting plans for perfecting aerospace techniques, shapes, materials, and manufacturing processes. Avco is proud to lend a hand.

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